COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY

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Dedicated

to

my family

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Teachers

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LIST OF ABBREVIATIONS

FS	Frozen section
TP	Touch Prints
OT	Operation theatre
ALND	Axillary lymph node dissection
SLN	Sentinel lymph nodes
TIC	Touch imprint cytology
EC	Endometrial cancer
PS	Paraffin section
IOC	Intraoperative consultation
SNT	Subnipple tissue
IC	Imprint cytology
HPE	Histopathological examination
DPX	Dibutylphthalate Polystyrene Xylene
H&E	Haemotoxylin and eosin
PPV	Positive predictive value
NPV	Negative predictive value

ABSTRACT

Introduction: Tissue specimens taken from the patient during the surgery (frozen section and imprint cytology) were studied and then correlated with the final histolopathological examination.

Aims & Objectives: To compare diagnostic accuracy of imprint cytology and frozen section with the gold standard histopathological evaluation.

Material & Methods: This study was conducted in the Department of Pathology ,Dayanand Medical College and Hospital, Ludhiana over a period of 1 year prospectively from 15th September 2022 to 14th September 2023. Fresh unfixed tissue specimens sent for frozen section examination were examined grossly and frozen sections from the representative areas were processed along with making 3 imprints on glass slides. Imprint slides were stained with Toludine blue stain, Giemsa stain and Haemotoxylin and eosin stain. Frozen sections were stained with rapid Haemotoxylin and Eosin (H&E) stain and Toludine blue stain. Imprint slides and frozen section slides were examined and result was immediately conveyed to the operating surgeon. The rest of the specimen was fixed in 10% of formalin and grossed with representative sections. The results of both the techniques were compared to final histopathological diagnosis which was considered the gold standard.

Results: We received a total of 281 specimens, out of which 45.19% were for primary diagnosis, 38.4% were for evidence of metastasis, 14.23% to assess the resected margin status and 2.13% to look for infection. Overall sensitivity, specificity, PPV, NPV of imprint cytology were 91.7%, 95.05%, 90.8% and 95.5% and for frozen section were 94.7%,98.4%,96.7% and 96.7%.

Conclusion: We conclude that imprint cytology can be used as an adjunct to frozen section for better diagnosis. Imprint cytology is a boon for resource-deprived settings and frozen section compliments it in tertiary care centres for intraoperative diagnosis and in determining the extent of surgical intervention required.

Keywords: Frozen section, imprint cytology, Histopathological findings.

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INTRODUCTION

Frozen sections have long been a vital part of surgical excisions, and every surgical institution mandates the presence of a cryostat and the expertise of pathologists in order to carry out procedures effectively. Pathologists play a vital role in the surgical management of many diseases due to their expertise in studying and diagnosing pathological conditions. The frozen section diagnosis is promptly transmitted to the operating surgeon over phone or intercoms due to its significant influence on the surgeon's intra-operative decision-making. Alternatively, there are other efficient and simple examinations that can be conducted, such as examining the cellular structure of the excised tissue by imprint cytology, which can provide a rapid evaluation of the tissue. Imprint cytology can provide precise results within minutes while the patient is still under anesthesia. Both Imprint cytology and frozen section are important in cases where cytological or biopsy findings are inconclusive, especially in evaluating margins and intra-operative nodal status.

Imprint cytology is a tool used for analyzing tissue during surgery and the immediate period after the surgery. The introduction of this concept was first carried out by Dudgeon and Patrick in 1927 [1]. Intraoperative touch imprint cytology does not require tissue freezing. Current specimens are compressed against a surface in order to gather samples. Touch imprint cytology is a simple, rapid, and cost-effective technique. Furthermore, impression smears offer outstanding cytomorphology. Thyroid nodules, central nervous system lesions, and lymphoproliferative lesions are extremely dependable indicators for imprint cytology. In addition, imprint cytology can be used to get samples of tissue that would be challenging to slice using a cryostat and to handle small specimens.

The freezing of tissue is a quick technique that can be employed to solidify tissue to a degree that permits the creation of thin sections. Lang is credited as the first to use freezing procedures to strengthen

tissues throughout the 1800s. In 1818, De Riemer was the first to employ this approach for histological diagnosis [2]

In 1891, William Halsted, a medical professional at John Hopkins Hospital, requested pathologist Welch to conduct the initial intraoperative frozen section on a woman who was likely suffering from breast cancer.[3]

The cryomicrotome, commonly referred to as a cryostat, was developed in 1959, and its use brought about a significant transformation in the FS technique. A cryostat is a chilled enclosure that houses a rotating microtome and maintains an interior temperature between -20° and -30° Celsius. The tissue section is handled by the technician in charge. The tissue is cryogenically preserved using frozen sprays of aerosol and subsequently positioned in the cryostat for the purpose of sectioning. The water present between and within cells undergoes solidification, resulting in the development of a rigid framework that allows for the cutting of tissues. [4] While frozen sections closely resemble histological paraffin sections when it comes to tissue architecture, they are frequently hampered by freezing artifacts that can affect the evaluation of the lesion's morphology. Imprint cytology is a highly effective technique that improves the accuracy of frozen section analysis in intraoperative consultation by providing distinct and exact cellular details.

There are numerous benefits associated with the utilization of frozen sections and imprint cytology, some of which are outlined here.

1) To determine the characteristics of the abnormal tissue, such as if it is cancerous or benign.[5] The operating surgeon has to meticulously assess this information, as it will influence the precise sort of operation to be performed and whether additional sampling is required.

2) To evaluate a growth in a surgically uncertain region and determining the existence of a second growth that was accidentally discovered during the operation. [6].

3) To evaluate the surgical margins for presence and absence of tumor. [7- 8]

4) To evaluate the degree of lymph node metastases in the area. At times, it is also employed to determine the extent of cancer spreading to a remote organ.[9-10]

5) To know the origin of organ while working with small and challenging-to-identify tissue, such as parathyroid glands.[11]

6) To confirm the presence of infection, one needs to look for the presence of fungal infection, granuloma, and tissue inflammation.[12 -13]

The objective of this study is to examine the various indications for conducting imprint cytology and frozen section in our particular setting, and to evaluate the precision and sensitivity of both techniques by comparing them to the ultimate histopathology report, which is regarded as the gold standard.

AIMS AND OBJECTIVES

To compare diagnostic accuracy of imprint cytology and frozen section with the gold standard histopathological evaluation on formalin fixed paraffin embedded tissue.

REVIEW OF LITERATURE

The primary intent of the intraoperative pathology consultation is to offer advice regarding swift surgical care.[14] Surgeons demand intraoperative consultations for various objectives, including detecting an anonymous lesion (mainly differentiating between the benign and malignant), assessing the status of the margins, determining the spread of disease (such as lymph node metastasis), and quickly assessing the adequacy of the tissue influenced by the lesion. [15] Imprint cytology and frozen section are two frequently utilized tests for intraoperative diagnosis.[16] One of the most vital instruments utilized throughout surgery to handle cases is FS, requiring teamwork with pathologists and technicians.[17] Multiple variables may influence the accuracy of FS diagnosis, including the dimensions of the tumors, the histologic type, and the degree competence of the pathologist.[18]

The imprints from recently excised surgical specimens offer excellent cytomorphology, and when paired with rapidly staining, an entirely accurate diagnosis can be given within minutes. Touch imprint cytology is an invaluable tool in experimental and medical diagnostics because of its simplicity, speed, cost-effectiveness, and capacity to optimize the recovery of cells from microscopic tissue bits.[19]

The touch imprint technique first reported within the medical journals in 1927 by London-based researchers Dudgeon and Patrick. Researchers developed an easy strategy for quickly generating imprints using freshly diced specimens. [20] The investigators analyzed 200 successive specimens and found that the imprints displayed a trustworthy ability for precise diagnosis when compared with tissue sections fixed in formalin-fixed paraffin. In the meantime, touch imprints have been widely utilized in multiple organ systems. [21-22]

Earlier FS techniques were demanding and rigorous, and required combined artistic skill and scientific knowledge. The widespread adoption of the strategy has been credited to personalities such as Hazard, Stevenson, and Dockerty.[23]

Hazard and Stevenson in 1949 developed an approach which was intriguing when contrasted to contemporary processes including the use of a cryostat. The recently collected specimen was submerged in a solution of fixative that was ten times larger than its volume and warmed to just near the boiling point and block was then solidified by placing it between dry ice fragments and sliced at an average thickness of 10–15 um using a microtome blade. The sections were transferred into a beaker containing distilled water. Then, the slice was transferred using a glass rod into a beaker filled with a mixture of carbol fuschsin and toluidine blue solution. After multiple washes in many beakers filled with distilled water, the tissue was fixed on glass slide and covered with a 30% solution of sucrose or cane sugar, before being covered with a coverslip. This procedure lasted for an hour. If the coverslip was coated with permount or flexible colloidan, the section could be conserved for multiple days.

In 1953, Dockerty made modifications to the Hazard and Stevenson approach in which, he froze the tissue without fixing it and connected it directly to a microtome.

Teloh HA [24] accomplished significant advances by directly putting the unfixed tissue onto the freezing stage of the microtome. The tissue was then swiftly frozen via periodic release of carbon dioxide gas. After freezing, the tissue was cut at a thickness of 25um as well as stained using a drop of aqueous thionin solution. The thionin stain typically dissipates during a period of 48 hours. For the permanent section, Teloh recommended subjecting the section to a few drops of 95% alcohol and staining it using the haematoxylin and eosin (H&E) technique commonly used for paraffin-embedded tissue sections. Slides generated using this method could be saved indefinitely.

The introduction of the cryostat in 1959 enabled tissue to become sufficiently hardened to for thin sectioning. In order to conduct a frozen section, it is necessary to select the appropriate tissue. This can be achieved by following the methods outlined below. The tissue is

physically examined. Orientation must be preserved when it is of utmost importance. Upon initial inspection, the specimen is subjected to a thorough examination. If the specimen is of substantial size, it is further analyzed using a process known as serial sectioning. For instance, for handling skin-covered tissues, it is recommended to cut sections that are perpendicular to the epidermal surface and for colon samples, sections should be cut in a way that is perpendicular to the mucosal surface. In order to achieve optimal freezing, it is recommended that the portions have dimensions of no more than 8 mm by 8 mm by 1-2 mm (thick). If the tissue is damp, delicately dab it to eliminate the moisture. Cryogenic-induced tissue changes are permanent. In order to minimize the size of crystals, it is advisable to freeze tissue promptly, as larger crystals tend to form gradually over time. If everything proceeds smoothly, the entire operation typically lasts approximately 5 to 10 minutes. This is solely for the purpose of creating the slides. The period that it takes for the pathologist to examine the slides under the microscope and get a diagnosis is separate from this. A global survey conducted across 700 laboratories revealed that 90% of frozen section block turn around time were completed within a span of 20 minutes. This measurement was taken from the moment pathologists received the specimen to the point at which they provided diagnoses to surgeons. [25]

In imprint cytology, the newly cut part of the specimen is delicately driven onto a glass slide to prevent distortion of the cell's shape caused by excessive sliding. The glass slides are pre-labelled with the patients' initials, the place, and the type of specimen. The specimen is bisected. The surplus blood on the sliced area is removed by wiping it with filter paper or damp gauze.[26] In order to avoid contamination, a unique surgical blade is employed for every specimen. Crush, imprint, and scrape smears are made from tumours, surgical margins, and lymph nodes, depending on the consistency of the lesion. Touch impressions are created by softly but strongly pressing the newly sliced, flat surface of the specimen against a glass slide, repeating the process two or

three times. For crush smears, the minute particles are gathered on a glass slide and compressed using another slide. For fibrous or sclerotic lesions, the blade is used to remove the surface and the gathered material is then spread onto a slide. Each specimen requires a minimum of three smears to be prepared. The smears are derived from the excised material and no extra tissue is gathered specifically for the investigation. During the process of making smears from a lymph node, the lymph node that has just been obtained is measured and the fibrofatty tissue that surrounds it is removed without causing any damage to the capsule. The excised lymph nodes are divided into two equal halves along their greatest dimension. Next, the slide is treated with hematoxylin and eosin stain, May Grunwald giemsa stain, and toluidine blue stain. Before that, it is fixed with 95% ethyl alcohol for 5-6 seconds. This entire process is carried out while the tissue is being frozen, ensuring that there is no delay in completing the frozen section.[27]

Type of Tissue:

Imprint cytology is a method used to evaluate biopsies of various specimen kinds. Imprints are appropriate for tiny biopsies, such as core needle biopsies. Imprints can produce informative slides if utilized on lesions that are not sclerotic. However, they are suboptimal for cystic lesions. This approach is highly beneficial in the case of soft and fragile tumors, such as glioma, as it effectively demonstrates a high level of cellularity on a smear. [28] Furthermore, cytology smears offer better identification of nuclear and cytoplasmic features.

Frozen section refers to the process of cutting any type of tissue using a scalpel or microtome for the purpose of analysis. Adipose tissue requires lower temperatures and presents difficulties in cutting. It is not possible to cut bone and other solidified lesions. Scraping preparations from bone can be used to examine the boundaries of the marrow on bones. Highly calcified lesions are usually noncancerous and do not need to be assessed by frozen section analysis during surgery. Excess

adipose tissue that is not essential for diagnosis should be excised from crucial areas of the specimen.

Touch preparation technique-

Applying the correct method is crucial for establishing an accurate and well-preserved representation of cells from a tissue sample on a glass slide. This ensures that the cytomorphologic architecture is maintained without any distortions or significant loss of diagnostic material. The general principles for correct technique can be described as follows:

1. Gently place the tissue along the shorter side of the slide to reduce any potential movement.

2. Typically, stroking a tissue once or twice is sufficient in most situations.
3. Avoid extending tissue biopsies for more than 1 cm along the slide.
4. Carefully manipulate the biopsy to minimize tissue manipulation.
5. The touch and pick method is most suitable for fragile tissues that are prone to breaking apart.

6. Utilize uncoated slides to minimize tissue adhesion and hence prevent tissue fragmentation.

Typically, it is not desirable to conduct touch imprinting on frosted slides. The touch imprint technique is a straightforward method that entails placing a biopsy onto a glass slide by gently touching it. This can be accomplished by many techniques.[29-31] The "drag method" involves placing a tissue biopsy onto a glass slide and gently moving it over the surface of the slide using a needle tip, wooden applicator stick, or the edge of another glass slide. The "roll method" involves delicately rolling a tissue on a glass slide using the tip of a needle or similar tool. This is most appropriate for dense and rigid tissue that can be readily shaped into a cylindrical form, such as bone cores. A different technique for rolling can be implemented utilizing more pliable tissue by affixing it to a plastic needle cover and thereafter rolling it

delicately on the slide. However, if the tissue adheres to this sheath, valuable cells could be lost. Therefore, once the touch imprint is created, the plastic needle sheath is immediately submerged into the formalin container and gently agitated to separate the tissue core. This aids in reducing core manipulation. The "touch and pick method" involves delicately using a needle or stick to make contact with a tissue biopsy, placing it onto a clean glass slide, lifting it without causing any dragging, and then carefully enabling the tissue to come into contact with another section of the slide. Excessive repetition of this action should be avoided as it can potentially harm the central part, result in streaking imperfections, and unnecessarily remove a large number of cells from the tissue core. Pre-moistening a slide can help prevent tissue from adhering tightly to the slide, facilitating its manipulation. Lastly, there is the "sandwich" technique, in which a second glass slide is delicately positioned on the tissue to produce an impression. Avoid using forceps since they have the potential to cause cell damage through crushing. Slides made using any of the listed techniques can be dried in the air or fixed while wet, for example, by immediately immersing them in 95% ethanol. Air-dried specimens can be stained using Romanowsky-type dyes, such as Diff-Quik. Wet-fixed slides can also be stained using May Grunwald Giemsa stain, Toluidine blue stain, and Haematoxylin and eosin.

Challenges and drawbacks in Imprint cytology- Artifacts in Imprint cytology can cause distortion or concealment of cytomorphology, leading to a diagnostic challenge.

1. Common visual indicators of TPs include streaking, compressed cells, and dense clusters that impede the visualization of individual cells. [29] Cell streaking is the result of tissues being pulled, even if it is only a small amount, across the slide. Streaking is more prevalent in cases of lymphoid lesions and small cell neuroendocrine cancer. 2. Specific cytologic characteristics that are typically observed in fine needle aspiration samples prepared using direct smears, such as

lymphoglandular bodies in lymphoid lesions or a tigroid background in glycogen-rich neoplasms (e.g., seminoma, Ewing sarcoma), may not be visible in imprints.

3.Excessive manipulation of fragile tissue cores can lead to their fragmentation, which is a significant issue with necrotic lesions.

4. Lesions having a significant quantity of myxoid or mucoid material can result in the disintegration or inappropriate loss of tissue. 5.One significant criticism of imprints is the possibility of losing significant portions or all of the cellular material on the slide. This can lead to a lack of surviving cancerous cells in the tissues for further examination and insufficient material for additional testing. This phenomenon commonly arises from forceful manipulation (e.g., excessive dragging) of the tissue during an imprint procedure. In order to illustrate this limitation, Rekhtman et conducted an experiment where tissue biopsies were utilized to create tissue preparations. These preparations were then pulled over a glass slide for varying distances.[32]The cellularity observed on the imprint slides increased in relation to the associated tissue biopsies, with raises of 19% for imprint only, 33% for 1-cm drag, 41% for 2-cm drag, and 46% with full-slide drag. Yet, this increase in cellularity additionally contributed to a proportional reduction in the nuclear content from the tissue, with decreases of 15% for imprint only, 36% for 1-cm drag, and 50% for 2-cm drag. It is important to mention that there was no discrepancy in the ability to accurately diagnose between fewer and more comprehensive impressions. In a study conducted by Tong et al, 1100 core needle biopsy cases with associated imprints were evaluated. The researchers discovered that 48 cases (4.4%) exhibited a lower number of cancer cells in the imprints contrasted to the corresponding biopsy, while 36 cases (3.3%) showed a higher number of tumor cells in the imprints when compared to the core needle biopsy.[33] Researchers additionally demonstrated that the lung, bone, as well as softer tissue were the three main sites where there were substantial variations in

the amount of cells.[33] The diameter of the biopsy instrument's needle also had a significant effect on the reduction of tumor cells in this investigation. All lung core biopsy specimens without tumor cells utilized a 20-G needle, but none of the lung biopsies performed using an 18-G needle remained entirely free of tumor cells. Consequently, it is advised to refrain from using aggressive TPs. In order to address the negative consequence of cell depletion, it is advisable to ask for an extra intact core to guarantee a sufficient number of tumor cells for ancillary testing.

6. Intraoperative imprint cytology is not suitable for pathologies where the cells do not separate easily, such as thick fibrosis or bone tumors[34] , to assess the extent of tumor permeation, [35] differentiate among in situ carcinoma and invasive carcinoma, distinguish adenoma from carcinoma, diagnose well-differentiated neoplasms, evaluate specific inflammatory diseases, and assess joint tissue during intraoperative consultation of arthroplasty revisions to determine neutrophil counts.

Frozen section technique-

Chuck: The metal platform is utilized for supporting the embedding medium and tissue during the process of sectioning. The chucks, composed of stainless steel, are designed to optimize their freezing capacity and longevity. They are stored in a bin positioned at a suitable and easily accessible location within the cryostat, placed at a lower level.

Base: The base is the substance used to embed and freeze the tissue, providing a cushioning and protective layer.

Block: It refers to the tissue that has been frozen at its base and is then covered with an additional embedding medium.

Dispensing slide: Thin, transparent vinyl material that is used to accurately position tissue and transfer it to the embedding well floor.

Preparation of block and freezing the tissue:

There are multiple methods for creating a foundation of embedding medium, which depend on the particular cryostat and equipment being used. Tissue can be transferred to a frozen basis through direct contact between the base and the tissue. To minimize the loss of tissue and guarantee an even block, the bottom of the specimen can be cut in advance and set up on a cryostat, especially when dealing with extremely small samples. The specimens can be preserved by freezing them in a cryogenic mixture, such as isopentane cooled by dry ice. Alternatively, they can be placed on a thin coating of cryocompound on a specimen holder, which is then placed on the freezing shelf, Peltier stage, or a big cooled metal block inside the cryochamber. The objective is to rapidly freeze the specimen in order to prevent the creation of ice crystals, also known as freeze artifact. In order to achieve rapid freezing, it is crucial to meticulously control the size of the specimen. As a general recommendation, a reasonable specimen size would be 2 cm x 2 cm × 2 mm. Thin segments can be rolled and positioned in perpendicular sections. When sending numerous fragments for frozen section, it is important to position them in close proximity to one another, but they should not touch. The embedding media is used to fully encapsulate the tissue, ensuring that it does not exceed the boundaries of the chuck. If the medium extends beyond the back of the chuck, it must be removed to avoid any interference when attaching the chuck to the cryostat. The product can be refrigerated to lower its temperature and accelerate the freezing process. It should encircle the tissue and provide support in maintaining the tissue's position. The tissue block, covered with a chuck, is placed in a cryostat for freezing.

Different types of tissues are most effectively sliced at different temperatures. Most tissues are typically stored at temperatures ranging from -10 to -20 degrees Celsius. Tissues with delicate textures such as the brain, spleen, adrenal gland, and lymph node are

subjected to subzero temperatures ranging from -7 to -10 degrees Celsius. Adipose tissue is cryopreserved at temperatures ranging from -20 degrees Celsius to -40 degrees Celsius.[4]

Sectioning on Cryostat:

The Chuck is aligned in the microtome to initially slice the densest part of the tissue, followed by sectioning the rest of the tissue. The portions of the tissue that possess the greatest amount of tissue should be put in the nearest distance to the blade. Commencing the incision by slicing fat tissue early is not suitable. The epidermal or mucosal surfaces should be positioned at a right angle to the blade. To achieve optimal thin section production, the blade must possess a highly sharp edge and be completely devoid of any imperfections or notches. Chatter artifacts and/or holes can develop in the resulting portions if the blades are dull or contain nicks. The block is trimmed until a complete section is obtained, and the bases can be prepared in advance before inserting the specimen to minimize the loss of tissue during block facing. After making coarse cuts, one could resort to large brushes or cotton swabs to clean the blade. Ensure that the brush is consistently going parallel to the blade. To mitigate the potential danger of a deep cut caused by the blade, it is imperative to refrain from manually removing the part. To prevent curling, the segment is partially connected to the block. Cryostats are utilized to create and sustain a low-temperature setting for the preservation of brushes. Set the micrometre of the microtome to a thickness of 15 µm for trimming. Start turning the microtome handwheel to advance the specimen by this specified value. As a result, the specimen will come into contact with the knife and the surface of the block will be sectioned. The act of achieving a full face section of the specimen is referred to as "trimming" or "facing" the block. The glass slide is delicately placed onto the surface of the tissue segment. Labelling the slides with the case number and specifying if they are frozen section is imperative. The staining solutions must be non-reactive with the label and able to

withstand their presence. When a frozen tissue is placed on a slide maintained at room temperature, it rapidly thaws.[36]

Fixation:

Once the slides are prepared, they should be immersed in methanol. Every instance of delay results in a substantial accumulation of air-drying artifacts, hence complicating the process of interpretation.

Disposition of Frozen Tissue:

Ensure that any leftover tissue is preserved by fixing it in formalin and thereafter submitting it for permanent sectioning. The remaining small frozen sections are enveloped with lens paper before to being placed inside labelled cassettes. To facilitate partial thawing, frozen tissue blocks can be momentarily immersed in formalin, and then manually or with the aid of a ruler, they can be extracted. Eliminate any extraneous embedded media that is not essential. Comparing frozen and permanent parts is a crucial quality assurance criterion. If there is a disagreement in understanding, it is necessary to notify the surgeon and provide a detailed explanation of the discrepancy in the final pathology report. The precision rates of frozen section in Western literature have been extensively recorded and reported.[37-42].

Problems and pitfalls of frozen section technique:

It is important to examine the limitations of FS when requesting this surgery to prevent serious mistakes that could harm the patient's treatment. The constraints can be categorized into three primary groups: sample error, technical issues, and interpretation mistake. [43-44]

1.Sampling errors or limitation

(i) Inadequate tissue sample / constraint imposed by the surgeons. This constraint is readily apparent for the pathologist, as they are required to interpret the tissue provided by the surgeon without any alternative options. Occasionally, the pathologist and radiologist may

need to enter the OT in order to assess the sampled tissue.

(ii) Inadequate choice of suitable tissue during the initial examination. When a tissue sample is sent to the laboratory for FS, it can be quite large. As a result, the pathologist must exercise his/her judgment to select the most representative regions of the tissue for sampling. This could have a significant impact on his interpretation. Occasionally, the positioning of the tissue being transferred is ambiguous, making it crucial to establish effective communication with the surgeon in the operating theatre.

(iii) Significant tumor degeneration or necrosis. Obtaining a representative sample from a sizable tumor might be challenging at times. The surgeon must select a viable region and avoid any necrotic areas. It is crucial to identify areas of tissue response to tumors, such as edema and fibrosis, as sampling these areas may occasionally result in the pathologist having no diagnostic material.
(iv) Inadequate evaluation of the presence of capsular or vascular invasion.
Evaluating the presence of capsular or vascular invasion in frozen section samples is extremely challenging and prone to sampling errors. Thus, evaluating this situation in endocrine tumors, particularly follicular carcinoma of the thyroid, is a subject of debate and necessitates effective communication between all involved parties.
(v) Presence of a malignant element within an ovarian teratoma. Identifying an immature component in an ovarian teratoma can be a lengthy process in frozen sections and is prone to sampling mistake. Sampling all tumors for intra-operative or pathology laboratory frozen section analysis is not feasible. Thus, a diagnosis of benign teratoma does not completely exclude the possibility of a malignant one unless the tumor is properly sampled at a later time.

2.Technical problems

(i) Artifacts caused by freezing or exposure to xylene.

Cryopreserving artifacts inflicts significant harm onto the tissue architecture of the frozen specimen. Drying artifacts occur due to insufficient treatment of xylene and poor coverslipping of slides, while the presence of water in the xylene solution leads to the formation of murky sections. All of these factors can significantly compromise the legibility of the slides.

(ii) Section of subpar quality. Sectioning frozen tissue is more challenging than sectioning paraffin-embedded tissue. The segment typically has a substantial thickness and occasionally exhibits folding. It is possible for air bubbles to readily enter the tissue sections. A substantial thickness can impede the clear visualization of nuclear characteristics, such as in cases of lymphoma, as well as the cytoplasmic details of histiocytes, oncocytes, and tumor cells. Moreover, the cutting of soft tissues such as the brain and fatty tissues poses challenges due to their resistance, resulting in frequent partial cuts and folding. These factors can potentially impact the accurate interpretation of the slides.

(iii) Enlarged cell structure. The preservation of cell shape depends on the quality and speed of the tissue freezing process, as well as its water content. Nevertheless, in the majority of cases of FS, the cellular structure is of worse quality compared to that of the paraffin-embedded segment. Frozen section tends to induce cellular enlargement and a bloated appearance, which the pathologist must account for while analyzing the tissue sample.

(iv) Section with inadequate staining. Similarly, the issue of fixation by freezing also impacts the staining quality of the sections. Pathologists rely on both color and shape to analyze cells and their surrounding tissues. This factor can influence their judgment. In order to enhance the morphology and staining quality of slide sections, several laboratories employ the practice of briefly exposing the tissue sample(s) to formalin prior to freezing. Nevertheless, this will result in a longer duration for the treatment.

3.Interpretative errors

Diagnosing FS can sometimes be challenging. The pathologist's policy is to provide the surgeon with the most accurate diagnosis feasible, while refraining from offering an accurate diagnosis if there is any uncertainty. It is advisable to postpone the final diagnosis of the case, particularly if the finding(s) would not affect the management during surgery. The following are some challenges that may be encountered in FS service.

(i) Challenging neoplasms to diagnose. Some tumors can imitate normal tissue or cells, as well differentiated angiosarcoma or signet ring cells in diffuse gastric cancer. The presence of malignant blood vessels in angiosarcoma can closely resemble normal blood vessels, making it challenging to accurately define the boundaries of healthy tissue in sarcoma. Similarly, the signet ring cells found in gastric cancer can resemble regular macrophages scattered throughout the gastric tissue, perhaps causing the pathologist to mistakenly diagnose the disease as chronic. The condition is characterized by inflammation rather than cancer.

(ii) Tumour heterogeneity. The presence of heterogeneity in soft tissue sarcomas poses a significant challenge in accurately diagnosing the lesion, both in frozen section analysis and in tissue biopsy specimens. A vascular malignant peripheral nerve sheath tumor may resemble a hemangiopericytoma, leading to potential misdiagnosis. Typically, instances of soft tissue sarcoma necessitate additional assessment through the utilization of specific stains and immunohistochemistry stains.

(iii) Mixed tumor and biphasic tumor. The presence of different germ cell components, such as teratomas, and tumors with biphasic characteristics, such as mesothelioma and synovial sarcoma, further complicates the diagnosis for pathologists due to the small tissue sample and time constraints in frozen section analysis.

(iv) Varying levels of tumor differentiation. Tumors like gliomas in the

brain and chondrosarcoma in the bone can exhibit varied levels of differentiation and tumor grading in frozen section analysis may not be reliable, as the surgeon may unintentionally miss sampling the higher grade cells of the tumor.

(v) Challenging differentiation between chronic pancreatitis and pancreatic cancer. Both chronic pancreatitis and pancreatic cancer result in the loss of the normal pancreatic tissue and provoke a significant fibroblastic reaction in the stroma. Moreover, the majority of pancreatic carcinoma glands closely resemble the benign glands of the pancreas, making it extremely challenging to diagnose pancreatic carcinoma after surgery, especially in cases of chronic pancreatitis. The accuracy of diagnosing pancreatic cancer is greatly impacted by the expertise of the surgeon and pathologist, with a potential accuracy rate of up to 98.3%.[45] The histological characteristics of malignancy encompass significant fluctuations in nuclear diameters, with a minimum ratio of 4:1, disarrayed distribution of ducts, incomplete lumens within the ducts, and the presence of invading individual cells. (vi) Challenges in evaluating ganglion cells and enlarged nerve bundles in Hirschsprung disease. Several types of cells in the gastrointestinal tissue, such as macrophages, endothelial cells, and lymphocytes, can resemble ganglion cells, particularly when they are grouped together. Furthermore, the artifacts resulting from tissue freezing, as previously mentioned, amplify the condition. Similarly, the naturally occurring wavy smooth muscles of the gut wall can be misinterpreted as an enlarged nerve bundle.

SLIDE PREPARATION:

FIXATION AND STAINING OF SLIDES

To achieve an accurate assessment using frozen sections, it is imperative to ensure that the tissue sections are of exceptional quality. By closely focusing on the rapid fixation and staining process, comparable findings can be achieved in a quick and suitable manner,

similar to those obtained from formalin-fixed, paraffin-embedded permanent sections.

Labelling of slides

The surgical pathology number and the sub-designation for the specific frozen segment are indicated on the labels affixed to the slides. Prior to usage, it is crucial to provide distinct names to slides in order to avoid any potential confusion amongst specimens. Utilize a pencil or a marker that possesses the quality of not disintegrating once the slide has been tinted. The label indicates the side of the slide where the tissue will be inserted. Plain glass slides are appropriate for most cytologic and frozen section preparations.

Types of fixatives

Fixatives can be produced using 95% ethanol, methanol, acetone, or a mixture of these substances. Various fixatives can be produced.

Stains

Hematoxylin and eosin, toluidine blue, Rapid Papanicolaou Stain, acetylcholinesterase, Oil red O, Rapid Periodic acid schiff-diastase, mucicarmine, and Alcian blue stains are some of the many stains used for frozen sectioning.[41]

The imprint slide is promptly immersed in 95% ethyl alcohol for a duration of 5-6 seconds and thereafter treated with a quick haematoxylin and eosin stain. The entire technique is carried out concurrently with the freezing period of the tissue preparation, ensuring that there is no delay in the completion of the frozen section. If one has a choice, they can also use a fast polychrome dye, such as toluidine blue, on heat-fixed slides.

Coverslip

A minuscule amount of mounting media is being applied to the periphery of the slide adjacent to the area of tissue in order to make

space for the positioning of the coverslip. The cover slip is inclined at an angle toward the edge of the slide, adjacent to the mounting medium. With caution, the cover slip is gently pressed onto the slide while evenly spreading the mounting medium, ensuring that no air bubbles are created.

Frozen section and imprint cytology of various organs:

The frozen section approach can be employed for several organs in the human body whilst the patient is undergoing surgery, aiding the surgeon in determining the most suitable subsequent surgical operation for the patient. Consequently, the several organs where frozen section is performed and their associated issues are detailed below.

1.LYMPH NODE:

Lymph node consultation is conducted to ascertain the presence of cancer in the sentinel lymph node(s) of individuals with breast cancer.[46] It is possible to detect metastases smaller than 2 millimeters, although their presence is not guaranteed. However, if such metastases are identified, they must be reported. Typically, surgeons do not conduct axillary lymph node dissection (ALND) on patients with pathologically-negative sentinel lymph nodes (SLNs). This approach helps to prevent several consequences such as lymphedema, paresthesias, limited shoulder movement, and reduced quality of life [47-49]. Nevertheless, if intraoperative sentinel lymph node biopsy reveals the presence of metastases in the sentinel lymph node (SLN), axillary lymph node dissection (ALND) can be performed in a single surgical procedure. It can efficiently avert the need for patients to undergo a second surgical procedure, experience more pain, and bear the financial burden.

Gross: When inspecting lymph nodes, it is important to be thorough in eliminating any fat that may be present on the surface and medulla. Begin by manually examining the node to determine its boundaries

and eliminate the visible adipose tissue by employing techniques such as smearing, compressing, incising, and scraping the excess fat off the node using either fingers or a scalpel. The lymph nodes were divided in half lengthwise and placed onto clean glass slides. They were then stained with Toluidine blue and fast giemsa stain for evaluation during surgery. The node is chopped into tiny sections at intervals of 2mm. Preserving non-frozen tissue is beneficial for conducting additional research, such as flow cytometry, molecular studies, and cultures for granulomatous disorders, when a node shows clear signs of being suspect for lymphoma or granulomatous disease.

Frozen section: FS, or frozen section, is the predominant technique used for intraoperative SLN identification in many reputable medical centers in China. This method is favored for its ability to accurately detect both macro-metastases and micro-metastases, and it is utilized in over 90% of cases. [50] The use of TIC in diagnosing negative SLNs is more precise compared to FS, indicating that TIC has a higher negative predictive value than FS.[51] Diagnosing SLN metastases in invasive lobular carcinoma is challenging due to the presence of many subtypes of lobular carcinoma with distinct cytological appearance. The alveolar form typically exhibits a rosette-like pattern, while the polymorphic type is more commonly associated with big cells. Regrettably, identifying these subtypes is challenging, except for a select few highly skilled pathologists using touch imprint cytology.

Imprint cytology: Metastatic carcinoma cells arrange themselves into cohesive clusters or sheets of abnormal cells, which are typically larger than even giant lymphoid cells when imprinted. Granulomatous inflammation can be detected on impressions through the observation of cluster of epithelioid histiocytes. These histiocytes have elongated, spindle-like and/or curved (a boomerang) nuclei, copious cytoplasm, and ambiguous cell boundaries, giving the appearance of a syncytium.[52,53] One may see the presence of multinucleated large cells, as well as significant necrosis and debris. A population of

lymphoid cells that have a single form enhances the chance of a lymphoproliferative illness when examined closely. This is especially true in most non-Hodgkin lymphomas, especially those of B-cell type, where the range of sizes of the lymphoid cells is more restricted.[54-56]

2.OVARY:

Ovarian specimens are frequently sent for intra-operative consultation to verify the existence of cancer. [57] and to assess the probability of metastasis in malignant mucinous carcinomas and compare it to the probability of initial carcinoma. In cases of carcinomas such as uterine carcinoma, the staging of the disease is influenced by the presence of ovarian involvement. When dealing with challenging situations, it can be useful to obtain more tissue from peritoneal nodules or extraovarian masses, or to examine the opposite ovary through frozen section analysis (in postmenopausal individuals). These approaches can assist in narrowing down the range of possible diagnoses. Primary ovarian carcinomas typically require comprehensive surgical staging, which involves performing a total hysterectomy, bilateral salpingo-oophorectomy, omentectomy, retroperitoneal lymph node dissection, and peritoneal biopsies. However, gynecologic staging surgery is not necessary for non-gynecological metastases to the ovary. Depending on the patient's age and desire to have children in the future, a conservative surgical procedure called cystectomy or unilateral salpingo-oophorectomy with restricted staging may be considered as a treatment option for borderline ovarian tumors. When there is no prior cancer history and there is a possibility that cancer has spread to the ovary, a peritoneal cavity examination is conducted to identify potential primary sites.

Gross: The key physical characteristics of ovarian epithelial tumors include their size, whether they are located on one side or both sides of the ovary, and the texture of the cut surface, which can be either cystic or solid. Most cystic ovarian tumors that have a smooth lining and no solid nodules are generally histologically benign. However,

benign epithelial tumors may also have a partially or wholly solid cut surface, such as adenofibromas or benign Brenner tumors. It is important to observe a significant amount of intracystic papillary growth, which is typically dispersed and solid in cyst adenofibromas, in contrast to the more plentiful, fragile, and easily crumbled intraluminal projection of serous borderline tumors. In contrast, malignant ovarian epithelial tumors typically have a solid composition, at least to some extent, and frequently exhibit a soft, squishy, and varied appearance on the cut surface, often accompanied by necrosis and bleeding. Bilateral occurrence is frequently observed in serous ovarian tumors, regardless of whether they are benign or malignant. However, the presence of bilateral mucinous tumors should always be regarded as a potential indication of metastasis. Furthermore, the size of the tumor can serve as a useful measure in distinguishing between primary and metastatic mucinous carcinoma. The macroscopic characteristics of cyst contents, specifically whether they are serous or mucoid, can potentially indicate the histologic subtype of the tumor. However, it is important to note that these characteristics may sometimes be deceptive, and the classification of the tumor should ultimately rely on the comprehensive microscopic examination and analysis of the cytoplasmic features of the epithelial cells that line the cyst. [58] When cutting tissue that is visibly filled with cysts or may have small cysts, it is advisable to apply little pressure with the fingers and scalpel.[59] If a cystic lesion contains sebaceous material and hair, it is highly probable that the source is a mature cystic teratoma, also known as a dermoid cyst. If there are little papillary growths or solid/nodular areas, it indicates a potential risk of cancer or borderline tumors. Sample could be extracted from the region that appears to be the most dubious. When there is a mass of blood present, the most frequent diagnoses are ovarian torsion, endometrioma, and nongestational choriocarcinoma. However, tumors can also occasionally lead to torsion. Mucinous tumors exhibit significant heterogeneity, making it necessary to use many frozen section blocks, particularly for bigger

tumors. An examination of the frozen slice of the opposite ovary, even if it appears visually normal, can be useful in detecting involvement on both sides. If just one of the ovaries is submitted for frozen section, the surgeon may be consulted to obtain information regarding the macroscopic appearance of the other ovary.

Frozen section: The histological diagnosis of the surgical resections can be categorized into three groups: benign, borderline, and malignant. The benign group includes fibrothecoma, mucinous cystadenoma, mature teratoma, struma ovarii, endometriotic cyst, serous cystadenofibroma, fibrothecoma, and serous cystadenoma. The malignant group include many types of carcinoma, such as serous carcinoma, mucinous carcinoma, endometrioid carcinoma, clear cell carcinoma, mixed carcinoma, undifferentiated carcinoma, or metastatic adenocarcinoma.[60] On frozen section, fibromas and leiomyomas may exhibit similarities, therefore justifying the diagnosis of a benign spindle cell neoplasm.

Imprint cytology: Scrape cytology is sometimes regarded as the most appropriate among the several cytological procedures used for examining ovarian material.[61-63]. Cytological diagnosis of borderline tumors during surgery is challenging due to the presence of both benign and borderline sections within the same tumor. Additionally, cytology cannot accurately assess stromal invasion.[64] Imprint cytology surpasses frozen sections in accurately detecting histological kinds of carcinoma, including clear cell carcinoma and mixed carcinoma. Obtaining an accurate histopathological diagnosis of FS of big tumours is often challenging due to the scarcity of tumour samples. Imprint cytology is a valuable technique for intraoperative consultation, since it allows for the collection of samples from large sections of the tumors.

3.GALL BLADDER:

The frozen tissue evaluation of a gallbladder is warranted when there is a polypoid mucosal lesion or a worrisome hypertrophy of the gallbladder wall. Diagnosis of xanthogranulomatous cholecystitis is

also possible.

A radical cholecystectomy is indicated when-

a. An invasive carcinoma was detected on a frozen section, regardless of the extent of invasion.

b. The FS examination detected dysplasia. Dysplasia frequently occurs alongside an invasive malignancy, which can go unnoticed during frozen section analysis due to errors in sampling or being obscured by inflammation.

c. During the surgery, the physician found a gallbladder lesion that appeared to be very likely cancerous. As a precautionary measure, the surgeon did an extended cholecystectomy, which included removing a wedge-shaped piece of the liver. The reason behind this decision was to prevent any violation of the tumor plane and the potential risk of upstaging if a malignancy is diagnosed.

The purpose of seeking FS and imprint cytology diagnosis was to confirm the initial diagnosis and assess the condition of the cystic duct margin. If the presence of gallbladder carcinoma is confirmed, the surgical procedure involved removing the part of the liver where the tumor was located, as well as performing a thorough removal of lymph nodes in three specific areas: station 8 (lymph nodes along the Common Hepatic artery), station 12 (lymph nodes along the hepatoduodenal ligament), and station 13 (lymph nodes posterior to the Superior pancreaticoduodenal artery). A pre-emptive prolonged cholecystectomy will be performed.[65]

Gross: Connective tissue can replace all layers of the gallbladder wall. The presence of polypoid, nodule, or mass lesions, as well as severe adhesions to surrounding tissues such as the liver, stomach, duodenum, or colon, should be considered. Additionally, changes in the color of the mucosa and a contracted or sclerotic mucosa should also be taken into account.[66]

Frozen section: Research on the dependability of frozen section assessment of the gallbladder demonstrates that the greatest level of reliability is achieved when evaluating intramural lesions. In about 95% of cases, there is agreement between the diagnosis made from the frozen section and the later permanent section. Identifying T1 lesions can be challenging when trying to differentiate them from dysplasia, especially when Rokitansky-Aschoff sinuses are present in cases with chronic cholecystitis.[67]

Imprint cytology: Imprint cytology is a viable option for tissue sampling due to its high cellularity, however it is not as effective as frozen section biopsy in determining the extent of tumor cell invasion.

4.ENDOMETRIUM:

FS and imprint cytology have the potential to determine the grade of the tumor, the degree of invasion into the myometrium, the histological type, as well as whether or not there is cervical extension in cases of endometrial cancer (EC). Intraoperative frozen section is the sole method for identifying, during surgery, the subset of patients who are at an elevated risk of extrauterine illness. This allows for precise guidance in achieving appropriate surgical staging[68-70]. If cancer is identified on imprints and frozen section, a surgical procedure called total abdominal hysterectomy and bilateral salpingooophorectomy with pelvic/para-aortic lymphadenectomy is performed.

Gross: Endometrial curettings are typically sent for the initial diagnosis, and they typically appear highly hemorrhagic. Occasionally, a hysterectomy specimen is submitted. The endometrial cavity is examined for the presence of any growth, polyp, and the thickness of the endometrium is assessed. The examination also includes an assessment of growth spreading into the myometrium. The goal is to determine the areas with the greatest depth of invasion during the surgery.

Frozen section: The selection of a portion of the endomyometrium for

evaluating the maximal depth of invasion is determined by a macroscopic examination of the tumor. This task may be challenging, as the discoveries can be inconspicuous, particularly when linked to a grade I tumor. Moreover, accurately determining the degree of myometrial involvement in cases of FS is difficult due to the highly variable invasion pattern and the possible occurrence of skip metastasis. An example of a technical artifact that is related to surgery or the FS process and could interfere with the evaluation of nuclear atypia.

Assessing supplementary sections would enhance the collaboration rate between the FS and PS, but it would also prolong the time required for diagnosis, so nullifying the benefit of this technique.[71]

Imprint cytology: If malignancy is present, smears will exhibit a higher number of cells with close proximity, disarray, and variation in both cellular and nuclear sizes within cell clusters. There will be a significant range in the shape and size of cells, along with an increase in the granularity of nuclear chromatin. Additionally, there will be an increase in the size, altered shape, and greater number of nucleoli. Abnormal mitotic figures will be observed, as well as a loss of cellular cohesiveness. These findings indicate a predisposition to cancer. Cellular detail is obscured by inflammation. The presence of inflammatory debris can sometimes be mistaken for tumor diathesis. Inflammatory smears can exhibit all the features of endometrial cancer cells, such as larger nuclei with varying sizes and shapes, increased staining intensity (hyperchromasia), and conspicuous and numerous nucleoli. Darkly stained nuclei in atrophic smears can be a potential source of error. [72]

5. PARATHYROID GLAND:

The goal of the consultation is to confirm the excision of parathyroid tissue, either in its entirety or as a biopsy, and to ensure the elimination of any aberrant parathyroid glands. Additionally, this is done to differentiate it from the thyroid gland. Following the excision of the

parathyroid gland(s) or confirmation through biopsy, there is no need for further surgical intervention. Surgical guidance can be achieved by distinguishing between adenoma, primary hyperplasia, and normal parathyroid. In exceptionally rare instances, the confirmation of parathyroid carcinoma can provide guidance for the completion of surgery.

Gross: The specimen, whether it is a biopsy or an excision of the entire gland, is observed during the process of grossing as a gland that has an oval shape. The entire gland is enveloped by a glossy and smooth capsule, similar in size and shape to a kidney bean. Dimensions and mass are considered. [73]. An adenoma is a solitary swollen gland surrounded by a border of normal tissue that can be observed when the gland is dissected. Multiple parathyroid glands are affected in chief cell hyperplasia. A biopsy is performed on a small fragment of tissue with an irregular shape. Inking should only be done if there is a clear clinical or obvious suspicion of malignancy. Carcinomas typically exhibit significant size, often exceeding 2 centimeters in diameter. The surgeon may remove any extra adherent tissue. Glands that are fully developed are divided into sections in a progressive manner.

Frozen section: The parathyroid acini exhibit hypertrophy and contain luminal material, giving them a resemblance to thyroid follicles that contain colloid. High quality frozen sections and identification of characteristic regions of either parathyroid or thyroid tissue enable differentiation, with parathyroid typically exhibiting smaller acini and vacuolated or transparent epithelial cell cytoplasm. Histological characteristics indicative of a carcinoma consist of a dense fibrous covering, fibrous partitions, a cellular arrangement resembling either trabeculae or rosettes, and a high occurrence of aberrant cell divisions, particularly mitoses.

Special stains: Oil red O is utilized to stain the parenchymal cells in healthy glands that contain a significant amount of intracytoplasmic

lipid droplets. This dye is employed to accentuate these drops. The presence of internal and extracellular parenchymal lipid content is completely eliminated in hyperfunctioning parathyroid cells. This stain can detect the border of a normal parathyroid gland, providing definitive proof of the presence of a parathyroid adenoma.

Imprint cytology: Typically, both normal parathyroid glands and adenomas consist of conventional chief cells, which may or may not have smaller populations of clear-type cell chief cells and oxyphilic cells. However, thyroid lesions do contain follicular epithelial cells, which can be challenging to differentiate from parathyroid cells in cytology preparations. The smears of the adenoma group displayed a combination of different patterns of architecture and cellular characteristics. These included small, reasonably uniform cells having round to oval nuclei that had stippled chromatin. The cells also showed cytoplasmic vacuolization and granular cytoplasm. The backdrop of the smears frequently lacked macrophages and colloid. [74]. Parathyroid cancer exhibits macronucleoli and pleomorphism in contrast to adenoma.

6.**BRAIN**:

The primary function of intraoperative diagnosis for a surgeon is twofold. Firstly, it involves ensuring that a sufficient and accurate tissue sample has been obtained, as performing a repeat biopsy can be extremely challenging. Secondly, it aims to determine the nature of the lesion, distinguishing between inflammatory or neoplastic, as well as benign or malignant. If there are suspected infectious lesions, it is necessary to get a microbiological sample. The goal in benign lesions is to achieve full excision, if it is anatomically and physiologically possible. During the surgical procedure for malignant lesions, the primary goal is to achieve maximal safe decompression. This is because patients with malignant lesions will inevitably need radiation and chemotherapy after the surgery. The surgeons are concerned about the possibility of not removing a benign lesion in the non-

eloquent zone that should have been removed, as well as the risk of removing inflammatory lesions or radio and chemosensitive tumors such as lymphomas and germinomas that should not have been removed.[75-78]

Frozen section method in case of brain tissue:_ Firstly, when freezing brain tissue, it is placed on a small support made of embedding medium, but the medium does not completely cover the tissue. Furthermore, the tissue is rapidly frozen by a gentle application of a metal heat extractor or cryospray to prevent the formation of ice crystals within the tissue. Ultimately, the block is meticulously divided into sections to maintain the integrity of the tissue while creating the slides. In several situations, it may be preferable to utilize cytologic preparations that do not require frozen sections. These circumstances include a finding of calcifications in the specimen, very small specimens, and suspicion of an infection.

Characteristics of the Smear: The texture of the tissue when sandwiched among glass slides can provide valuable insights into the characteristics of the abnormality. In imprint cytology, tissues are delicately compressed with minimal force and equally transferred to the edge of the slide using another clean slide. [79]. Schwannomas and fibroblastic meningiomas exhibit a firm texture, which poses challenges in their smearing process. Pituitary adenomas and other benign tumors with high cellularity and soft consistency can be readily spread into single-cell layers. The touch preparation method is most effective for treating firm, calcified, or fibrous lesions. In this process, the slide surface is gently and fleetingly touched (while the tissue is delicately held in forceps). Subsequently, the slide is promptly immersed in the fixative to prevent the occurrence of any desiccation-related artifacts. After the staining process is finished, the slide is analyzed to assess the uniformity of tissue distribution on the slide. The entire slide is carefully evaluated to account for the potential presence of diverse lesions. Diffuse patterns were observed in low-grade brain tumors such as pilocytic astrocytoma and cerebellar hemangioblastoma.

7. SKIN:

An intraoperative consultation (IOC) in dermatology is commonly performed to verify the complete excision of a malignant skin tumor. An IOC is infrequently employed to establish the principal diagnosis of a tumor. If the initial diagnosis was positive, in order to ensure clear margins, excess skin will be surgically excised surrounding the tumor.

Gross: Shave biopsies and punch biopsies may be rare. It is necessary to record the dimensions of the specimen, the extent of the excision, and the color of the skin and borders (whether they are well-defined or irregular) for all lesions. It is important to include the precise distance between the lesion or lesions and the margins. The precise location of the primary lesion may be concealed due to a prior biopsy. An illustrative figure depicting the alignment of the sutures, the pigments used, and the placement of the FS would be advantageous. The specimen is divided into sections in a consecutive order.

Frozen section: The frozen section consists of a section of skin that has closest perpendicular margin(s) and deep margin.

Reporting of Frozen section: Tumor existence or absence is confirmed and the specific type of tumor is identified. FS may not be able to determine the exact type of the tumor, such as poorly differentiated and sarcomatoid carcinomas. It is necessary to document the present status of the margin, indicating whether it is positive or negative. It is necessary to include the mention of perineural invasion in the report, if it is present. Lesions that are ideal for frozen section (FS) are characterized by indistinct clinical boundaries, an infiltrative pattern of growth on a microscopic level, being long-standing and big, recurring, or located in locations where preserving the skin is important.[80]

Imprint cytology: A crucial need for achieving excellent impression smears is to ensure that the cells of the lesion should readily exfoliate. This is particularly accurate for the epithelial tumors. Cells derived from

mesenchymal tissues generally do not detach easily, resulting in impression smears that are typically low in cell count. Typically, if it is not possible to obtain a diagnostic slide by drawing fluid from a tissue, it is improbable that an impression smear will have a high level of quality. Epithelial tumors, which are ulcerated skin cancers, have a tendency to peel easily. Therefore, they can be readily imprinted for a rapid cytological investigation.[81]

8. PERITONEAL/OMENTAL BIOPSY:

The differential diagnosis encompasses a wide range of conditions, including primary peritoneal cancers, benign illnesses such endometriosis, and inflammatory and viral diseases. Peritoneal implants typically occur in locations of the peritoneal fluid where there is a lack of movement: the pelvic peritoneal reflections, the right and left paracolic gutters, the upper section of the sigmoid mesocolon, the ileocolic area, and the right subdiaphragmatic space.[82] Laparotomy is still considered the most reliable method for determining the extent of peritoneal carcinomatosis. If a malignancy is discovered during a planned surgery, the surgical procedure may be altered. In cases where the presence of malignancy was unexpected, efforts may be made to locate the primary site of the cancer. If malignancy is already confirmed, the presence of metastatic disease can alter the intended surgical approach. Women with ovarian lesions may undergo peritoneal or omental sampling to detect the presence of an invasive implant. If a surgeon detects the presence of an intrusive implant, they may opt to implant a port for the administration of chemotherapy. The role of Peritoneal carcinomatosis, if identified, is to distinguish between patients who are suitable for surgery and those with widespread disease or unfavorable lesion sites, who should receive neoadjuvant or palliative chemotherapy.

Gross: For individuals with ovarian masses, the omentum can be surgically removed and examined during the operation to determine the presence and characteristics of implants. Typically, there is no need to

apply ink to the mass since primary solitary peritoneal cancers are exceptionally uncommon. The tissue is cut into sequential sections. The focal lesions are first recognized, and then their size, number, color, and boundaries are described.

Most common diagnoses in Omentum are as follows:

Metastatic Carcinoma (Nonovarian): For patients with a history of cancer or a currently diagnosed cancer, it is crucial to identify the specific type of cancer and ascertain if the patient has had any treatment. Gastrointestinal tumors frequently exhibit peritoneal metastasis and display a wide range of histologic characteristics. Colon cancer is usually characterized by the presence of glands that have different levels of cystic dilation. The glands are lined by tall columnar tumor cells, and it is common to find widespread core necrosis, which is sometimes referred to as "dirty" necrosis. Pancreatic carcinomas frequently exhibit metastasis at the time of surgery, which can be identified by the presence of mucinous glands, desmoplasia, and perineural invasion. These characteristics are generally useful in diagnosing this type of tumor. If metastatic disease is detected, surgery performed with the intention of curing the patient is frequently halted. Signet ring cell gastric carcinoma has the ability to spread to other parts of the body. These cancer cells are characterized by their small size and lack of mucin in the cytoplasm, which can make them mimic histiocytes or lymphocytes. Identifying these cells can be challenging. Identifying enlarged cells with several mucin vacuoles that displace nuclei is easier.

If the main diagnosis is unclear, it is important to consider lobular cancer of the breast as a potential cause, as it can have a remarkably similar appearance.

These carcinomas frequently lack a desmoplastic response. The infiltration into the adipose tissue may have a somewhat lighter color and increased rigidity compared to the usual tissue. Tumor cells have the ability to mimic reactive mesothelial cells.

Pseudomyxoma peritonei commonly arises as a result of a primary tumor in the appendix. The material consists mainly of mucin, with only a few scattered areas of mucinous epithelium that may or may not be visible on frozen section.

Neuroendocrine tumors are usually made up of clusters, cords, or layers of tumor cells, all of which exhibit salt and pepper chromatin. Non-abdominal cancers can also spread to the abdomen, although this is less often.

Ovarian Carcinoma: Metastasis is most commonly found in women with ovarian masses who have serous tumors, including borderline, low grade, and high grade tumors. High-grade carcinomas often have significant nuclear abnormalities, increased cell division, and widespread spread. Low-grade carcinomas may occasionally exhibit aggressive infiltration of underlying tissues, while their cellular appearance is relatively unremarkable when compared to high-grade carcinomas. Extraovarian implants can be inserted in women who are undergoing surgery and have borderline tumors, which have a low likelihood of progressing into malignancy. The type of implant is a critical determinant of prognosis.

Non invasive implant (borderline tumor): The presence of a desmoplastic reaction is linked to a noticeable response from the surrounding tissue and is characterized by the development of well-defined glandular structures that are surrounded by fibrous connective tissue. Epithelial lesions may exhibit the presence of papillae and glandular structures. Epithelial lesions do not have a prominent stromal reaction. The glands are organized in limited clusters. There is a possibility that there could be cell clusters that are not joined and papillae that are branching.

Invasive implant (low-grade serous carcinoma): The invasion is characterized by definite, irregular, and damaging penetration into the normal underlying tissue structures, accompanied by desmoplasia. If an intrusive implant is clearly identified on the frozen section, the

surgeon may opt to insert a catheter for chemotherapy during the surgical procedure.

Mesothelial lesions: Mesothelial hyperplasia, a frequently encountered condition, is often associated with a provoking factor such as peritonitis or endometriosis. As per the definition, there is no substantiated indication of infiltration into the underlying tissue. One can notice a diverse range of patterns, including tufts, papillae, spindle cells, tubules, solid nests, or single cells. Typically, mesothelial cells exhibit minimal nuclear atypia. There is either an absence or a minimal number of mitoses, which usually include a significant amount of cytoplasm. Necrosis can occur in cases of low-grade (well-differentiated) mesothelioma. This form of mesothelioma can present as cystic or papillary tumors. They are more common in females and are usually found incidentally during surgical operations. Generally, their size is less than two centimeters in length, yet there are occasional cases where the lesions are spread out. The presence of mitotic figures is rare or absent. There is a lack of evidence to support the existence of an invasion. When examining a frozen section, it can be difficult to distinguish between reactive and low-grade mesothelial lesions. Therefore, it is important to take enough samples for permanent sections to ensure accurate diagnosis. Malignant mesothelioma may manifest with a diverse range of histologic features, including as papillary, tubulopapillary, solid, sarcomatoid, and epithelioid. Invasion, necrosis, increased mitotic activity, and nuclear atypia are indicative of the development of a malignant tumor. Tumors are generally characterized by their substantial size and widespread presence. Nevertheless, certain locations may exhibit the visual characteristics of a low-quality tumor and may even have a resemblance to a well-developed or responsive growth.

Adenomatoid tumor: Adenomatoid tumors, which are benign growths of mesothelial cells, can form in the subserosa of the uterus, fallopian tube, testis, and epididymis. Extragenital regions, such as the mesentery or omentum, may be exceptionally uncommon. These

nodules are firm and have a tan-gray color. They are typically small, but can reach a diameter of up to three centimeters. Lymphocytic infiltrates or germinal centers are commonly detected. Cells have the ability to arrange themselves into either cord-like or tubular gaps inside a given framework. Border infiltration is possible. This can occur in either thick stroma or smooth muscle. The cells of the epithelium have a modest cuboidal shape, and their borders are clearly evident. Vacuoles have the ability to imitate mucin vacuoles. It is important to minimize nuclear atypia and ensure that mitoses are infrequent.

Peritoneal Inclusion Cyst: Cysts primarily impact females in the age range of 15 to 45 years old. It might either be a solitary occurrence or multiple occurrences. Cysts typically have a single chamber and thin walls, are covered by a single layer of unremarkable mesothelial cells, and contain transparent fluid. Cysts can, nevertheless, contain a diverse range of fluids. The presence of tiny cysts is commonly observed as an incidental finding. Significant cysts has the capacity to induce symptoms, and a portion of them exhibit multilocularity.

Endometriosis: This condition is characterized by the growth of large masses that vary in color from red to black. It specifically affects women who are in their reproductive age and has a visual resemblance to powder burns. Adhesions can occur as a consequence of both hemorrhage and inflammation. A reliable diagnosis necessitates the presence of three essential elements: The endometrial glands are distinguished by their elongated columnar cells that are organized in a solitary layer. Endometrial-type stroma is distinguished by its compact spindle-shaped cells that have the ability to undergo decidualization. Macrophages containing hemosiderin due to hemorrhage.

Endosalpingiosis: This disorder exclusively affects females and is typically detected serendipitously. On the peritoneum, it appears as discrete masses or fluid-filled sacs that can be either white or yellow in color. The structure is composed of small, scattered, uncomplicated glands lined by tubular epithelium and can also be located in lymph

nodes. Occasionally, there may be the presence of bigger cysts, simple intraluminal papillae, or cellular stratification. The borders of these structures are lined with secretory-type cells, peg cells, and ciliated cells. Cellular stratification may be observed in some instances. Glandular disease can be differentiated from endometriosis based on the absence of specific stroma.

Endocervicosis: Endocervicosis refers to the presence of benign glands of the endocervical type in the cul-de-sac and posterior uterine serosa in women with endocervicosis. Mucinous glands exhibit nuclei grouped in a basal orientation and contain a plentiful amount of eosinophilic cytoplasm that is mucinous in nature.

Gliomatosis: Gliomatosis is a condition when mature glial tissue is seen on the peritoneal surfaces. Ectopic tissue closely resembles mature glial tissue in the central nervous system, exhibiting similar features such as small round nuclei and abundant eosinophilic fibrillary cytoplasm. While it may be linked to ovarian teratoma, it does not have an impact on the prognosis.

Splenosis: Splenosis is frequently associated with previous abdominal traumas. Splenosis can present either as a solitary additional spleen or as scattered nodules with varying shades from red to brown. From a histological perspective, it is identical to the tissue found in the spleen.

Peritoneal Leiomyomatosis: It can occur either as the primary procedure or as a result of the morcellation of uterine leiomyomas. This disorder exclusively impacts females. It exhibits a histological appearance that is similar to uterine leiomyomas. The composition of this structure consists of unimpressive and spindled cells, with nuclei that are cigar-shaped. The cells are organized in bundles that intersect with each other. Mesonephric remains are located in proximity to the fallopian tube. The remains appear as glandular structures that are dispersed and enclosed by little bundles of smooth muscle. They are covered by a layer of low cuboidal epithelium. Eosinophilic secretions can be found in the lumens of these residual glands. Pancreatic tissue

that has been moved can be observed within the lining of the small intestine. Urachal remains are present in the apex of the urinary bladder.

Fat Necrosis: It may manifest as confined or irregular hard mass that may be calcified.

Granulomatous Peritonitis: Granulomas may be found in the peritoneum due to several factors, including the presence of keratin, infections caused by Mycobacterium tuberculosis, or fungal diseases such as Actinomycetes. It is also observable when compared to foreign substances like barium or plant material, which can spread into the peritoneum after a hole in the intestines. If a primary malignancy is already identified, the material can be definitively confirmed as a metastasis if the histologic characteristics of the original tumor and the peritoneal tumor are exactly the same. When dealing with lesions of uncertain malignancy, it is advisable to use the term "at least" in circumstances where the potential for malignancy is unknown. Therefore, it is necessary to report it as "at least reactive mesothelial hyperplasia, with the possibility of low-grade mesothelioma not being entirely ruled out. The definitive diagnosis will be determined by permanent sections if the lesion is not conclusively benign. When dealing with cases of unknown primary, where the primary tumor is not clearly recognized, it is customary to report it as "adenocarcinoma, not otherwise specified." If the defining features of an invasion are not definitive, it is advisable to categorize it temporarily until thorough assessments of the affected regions are conducted, while also minimizing the potential extent of harm that may occur.

9. RESECTED MARGINS:

Having negative surgical margins is crucial in preventing the return of cancer in the same area and increasing the chances of survival. Positive margins detected in permanent sections require additional surgeries, leading to a delay in initiating adjuvant therapy, compromised aesthetics due to the removal of a larger amount of

breast tissue compared to the initial surgery, increased risks associated with anesthesia, heightened patient anxiety, escalated costs, and greater morbidity. Surgeons frequently want information regarding whether an inflammatory or infectious process affects a resection margin or if the tissue at the margin is viable [83]. If the margins are positive, a revised margin must be pursued in order to have a successful surgery. If a negative margin is achieved, surgical extension is unnecessary.

Gross: If the specimen is too large to be completely frozen en face, the true margin should be determined. It is commonly recognized by the presence of a stitch or clip at one end of the section.

Frozen Section: The margin cross section is implanted with the true margin oriented upwards to guarantee that the initial frozen section will accurately represent the true margin. If a comprehensive cross section cannot be observed in the initial portions, it is advisable to continue to deeper layers. If there is substantial loss of the urothelium in the case of ureteric margins, it is advisable to obtain extra levels. However, it is challenging to apply this method to assess the cortical bony borders of dense bone. The additional margins provided are basal cell carcinoma margins, squamous cell carcinoma margins, and pancreatic duct margins.

Imprint cytology: If there are any tumor cells, they will stick to the slide. The diagnostic categories include: negative for carcinoma, presence of atypical cells without definitive evidence of carcinoma, presence of atypical cells, presence of atypical cells suspicious for carcinoma, and positive for carcinoma.

A study conducted by Otero J et al from June 1994 to June 2004 involved the performance of 525 imprint cytologies on the gallbladder mucosa. These cytologies were carried out after 160 open cholecystectomies and 365 laparoscopic cholecystectomies. The patients underwent surgery for acute or chronic cholecystitis caused by the presence of gallstones. Just 18 patients were diagnosed with

gallbladder cancer before their surgery. An analysis was conducted to determine the sensitivity, specificity, predictive values, accuracy, and confidence intervals (95% CIs) of intraoperative imprint cytology in diagnosing cancer. The mean duration for each treatment was 10 minutes. The average age of the patients was 69.2 years, ranging from 24 to 92 years. Out of the total number of patients, 342 (65.1%) were female and 183 (34.9%) were male. Out of the 58 diagnosed cases of gallbladder carcinomas, the imprint cytology approach yielded positive results in 44 cases. This indicates a sensitivity of 75.9% (44 out of 58 patients) and a specificity of 99.8% (466 out of 467). Out of the total cases (1/525; 0.2%), just one case was a false-positive. This occurred as a result of reactive alterations. The positive predictive value was 97.8% (44 out of 45; 95% confidence interval = 86.8–99.9), negative predictive value was 97.1% (466 out of 480; 95% confidence interval = 95.0–98.3), and accuracy was 97.1% (sum of 44 and 466 out of 525; 95% confidence interval = 95.2–98.3). In four instances, there was a lack of sufficient or suitable material.[84]

A study conducted by Munchar J. et al in 2005 involved the preparation of parathyroid tissue (n = 29), adipose tissue (n = 3), and thyroid tissue (n = 2) intraoperatively. The tissues were stained using May-Grünwald-Giemsa and Papanicolaou staining techniques and then sent for regular frozen section and standard paraffin section. A solitary pathologist, who examined the scrape cytology, was unaware of the findings from the frozen and standard paraffin sections. The process of scraping cytology successfully identified 25 out of 29 parathyroid tissues, all three adipose tissues, and one out of two thyroid tissues. Four parathyroid tissues and one thyroid tissue could not be identified due to insufficient sample size for identification. The outcome yielded a diagnostic accuracy of 88.2%, a sensitivity of 86%, and a specificity of 100%. The frozen section appropriately identified all tissues.[85]

The 2011 study conducted by M Francz et al determined the sensitivity and specificity of each of the three techniques for detecting metastatic cancer as follows: The accuracy rates for touch imprint cytology were

69.4% and 97.8%. For frozen sections, the rates were 58.3% and 100%. Rapid immunocytochemistry had accuracy rates of 68.5% and 98.9%. The combination of touch imprint cytology, frozen sections, touch imprint cytology plus rapid immunocytochemistry, or touch imprint cytology frozen section analysis and rapid immunocytochemistry resulted in the highest accuracy. Each of these methods had an identical sensitivity and specificity of 72.2% and 97.8%, respectively.[86]

In 2013, Nigam J et al conducted a study that included thirty cases of tumors and tumor-like lesions affecting the nose and paranasal sinuses. Cytological smears were created using the imprint/squash techniques from selected tissue samples and then stained with Leishman-Giemsa and Papanicolaou. The frozen section and paraffin-embedded section underwent staining using the haematoxylin and eosin stain. An expeditious assessment was provided regarding the benign or malignant characteristics of the lesion and the specific type of tumor. The sensitivity, specificity, and positive predictive value of imprint cytology, squash cytology, and frozen section were all 100%. For squash cytology, the specificity was 96.15% and the positive predictive value was 80.0%. The same values were seen for frozen section as well. The overall diagnostic accuracy of impression smears, squash smears, and frozen section was 100%, 96.7%, and 96.7% correspondingly. Imprint smears offer improved specificity since they allow for a more precise evaluation of cell morphology.[87]

A study conducted by Stephen J. et al in 2014 involved 116 individuals who had been diagnosed with either endometrioid adenocarcinoma of the uterus or complex atypical hyperplasia before undergoing surgery. Demographic data, together with information regarding stage, grade, histology, and depth of invasion found during FS and PS, were gathered. The agreement rate between FS and final PS for depth of invasion, grade, and histology was assessed using Cohen's kappa statistic. Their correlation rates between FS and final PS for histologic subtype, grade, and depth of myometrial invasion were 97.5%, 88%,

and 98.2% respectively. Out of the seven instances initially diagnosed as complicated atypical hyperplasia on frozen section analysis, it was later discovered that they were actually malignant on the final permanent section analysis. As a result, two patients did not receive adequate treatment.[88]

A study conducted by Duarte G. et al in December 2015 involved the removal of subnipple tissue(SNT), which was then subjected to frozen section, impression cytology, and permanent histology. The nipple underwent individual examination using paraffin histology, which was regarded as the most reliable and accurate method. The rate of occult nipple involvement was 11.7%. The frozen section, cytology, and permanent histology of SNT demonstrated accuracies of 86.8%, 76.5%, and 86.8% respectively. The sensitivities were 50%, 37.5%, and 62.5% respectively. The specificities were 91.7%, 81.7%, and 90% respectively. The positive predictive values were 44.4%, 21.4%, and 45.5% respectively. The negative predictive values were 93.2%, 90.7%, and 94.7% respectively. The frozen slice demonstrated comparable accuracy to permanent histology ($p = 0.77$), and both were superior to cytology ($p = 0.01$). The false negative rates were 6.8% for frozen section, 9.3% for cytology, and 5.3% for paraffin.[89]

A study conducted by Narang V et al in 2015 focused on the brain.Seventy-five specimens obtained during surgery were analyzed using cytology and frozen section examination. The majority of cases, 82.7%, consisted of neoplastic lesions, whereas the remaining 17.3% were nonneoplastic. The diagnostic precision of "squash smears" was determined to be 89.2%. The diagnostic accuracy of "touch imprints" was 78.4%. The limited precision of touch imprints was ascribed to inadequate cellular yield. The diagnostic precision of the "frozen section" technique was 75.7%. Nevertheless, the diagnosis accuracy as a whole was 96%.[90]

In a study done by Mahadevappa et al in the Department of Pathology at JSS Medical College, JSS University, Mysuru. The study spanned a

duration of two years, from October 2011 to September 2013. A comprehensive analysis was conducted on a total of 62 surgically removed breast specimens to assess the presence of IC, FS, and their connection with the histopathological diagnosis. After characterizing the overall characteristics, a sample of tissue was obtained, three smears were produced by pressing the tissue onto a surface, and the same tissue sample was then examined using frozen section (FS) and subsequently processed using standard histopathology (HP) techniques. The slides, which were generated by IC and FS, were analyzed and subsequently compared with the diagnosis made by HP. Among the 62 cases, 33 (53.23%) were classified as malignant and 29 (46.77%) were classified as benign. The sensitivity, specificity, and accuracy of IC were 100%, 96.43%, and 98.36%, respectively. For FS, these values were 100%, 96.55%, and 98.39%, respectively. The p-values for both variables were less than 0.001, demonstrating a substantial association with the HP research.[91]

A study conducted by Dutta S et al in December 2017 focused on soft tissues and lasted for one year. The study comprised a total of 41 patients who were identified with soft tissue sarcomas (STTs) based on clinical and radiological assessments. After the surgery, an impression smear was obtained for each tumor prior to placing the tissue in a solution of 10% formalin. Subsequently, histopathological examination(HPE) was conducted. The patients' ages varied from 4 months to 80 years, with an average of 35.6 ± 17.5 years. The male-to-female ratio was 1.05:1. HPE findings showed that 21 tumors (51.2%) were benign, while 20 tumors (48.8%) were malignant. Examination of the imprint smears showed that 16 tumors (39%) were determined to be benign, whereas 20 tumors (48.8%) were found to be malignant. IC yielded inconclusive results in 5 cases, accounting for 12.2% of the total. The IC demonstrated a sensitivity of 89.5% and a specificity of 82.35%. The IC has a positive predictive value of 85%. The diagnostic accuracy of immunohistochemistry for both benign and malignant tumors was determined to be 75%.[92]

A study conducted by Azami S et al in 2017 focused on ovarian tumors. The diagnosis of both benignity and malignancy was accurately determined by both IC and FS analysis. Within the borderline group, the diagnostic accuracy of IC was significantly lower (1/6: 16.6%) compared to FS (4/6: 66.6%). The diagnosis accuracy, encompassing benign, borderline, and malignant categories, was 90.9% (50/55) for IC and 96.3% (53/55) for FS. The diagnostic accuracy of IC (25/31: 80.6%) was higher than that of FS (21/31: 67.7%) for diagnosing different forms of carcinoma, particularly clear cell carcinoma (IC, 100%; FS, 80%) and mixed carcinoma (IC, 66.6%; FS, 16.6%).[93]

The study conducted by Abe M et al in 2020 was in which A systematic analysis was conducted on 49 consecutive patients diagnosed with node-negative breast cancer who had sentinel lymph node biopsy (SLNB) together with intraoperative touch TIC and frozen section FS analysis. The study period spanned from November 2017 to June 2019. The TIC samples were stained using Papanicolaou and Diff-Quick staining methods. Results were compared with standard postoperative paraffin slices. The TIC method required an average of 12 minutes for the Papanicolaou stain, whereas the Diff-Quick stain took an average of 10 minutes. The results obtained from both TIC stain procedures were identical. Conversely, the FS approach required an average of 80 minutes (which includes the transportation of samples to another hospital equipped with the appropriate tools). The TIC verified the presence of macrometastases in 5 instances. The two approaches diagnosed all macrometastases with identical accuracy. The TIC demonstrated a sensitivity and specificity of 100% in detecting macrometastases.[94]

A study conducted by Kedia A et al in 2023 involved 50 patients with probable gynecological neoplasms over a span of 12 months. Their intraoperative diagnosis was determined using frozen section and imprint cytology techniques to exclude the presence of benign or

malignant lesions, and the results were compared with the gold standard histology. Their study found that the majority of instances of female genital tract neoplasms occurred in individuals aged 19 to 76 years, with 60% of cases occurring in the postmenopausal age group. The overall diagnosis of cancers was determined to be 62%, 52%, and 76% based on imprint cytology, frozen section, and histological examination, respectively. The study determined that the diagnostic accuracy achieved using intraoperative imprint cytology is superior, with a rate of 80%, compared to frozen section analysis, which achieved a rate of 76%. Histopathology showed the highest number of true positive cases. Both frozen and imprint cytology indicated an identical number of true negative and false positive instances. Frozen section yielded a higher number of false negative cases compared to imprint cytology. The kappa coefficient was lower in frozen samples compared to histology, and higher in imprint samples compared to histopathology. The sensitivity, specificity, positive predictive value, and negative predictive value of imprint cytology were 77.5%, 90.0%, 96.9%, and 50%, respectively. For frozen section, same values were 72.5%, 90.0%, 96.7%, and 45.0%, respectively.[95]

MATERIALS AND METHODS

Source of Data

All the frozen section tissues of all the organs received in the Department of Pathology in Dayanand Medical College and Hospital, Ludhiana over a period of 1 year prospectively (15th September 2022-14th September 2023) were assessed and imprint cytology and frozen section diagnosis was compared with histological sections.

METHOD OF COLLECTION OF DATA

INCLUSION CRITERIA

All frozen sections received in the pathology department

EXCLUSION CRITERIA

All the histopathological specimen for which frozen section was not sent.

FROZEN SECTION PROCESSING

The principle of cutting frozen sections is simple that is when the tissue is frozen, the interstitial water in the tissue turns to ice and in this state the tissue is firm, the ice acts as the embedding medium. For frozen sectioning the following steps were followed:

- Embedding media like Cryogel was placed on an appropriate sized chuck that was precooled in the cryostat
- The chuck was placed into a -20 to -15 degree (optimal) cryostat
- The tissue was placed on the semisolid chuck and more media was added rapidly over the tissue, covering it entirely but avoiding overflow
- The chuck was quickly placed back into the cryostat
- "Quick freeze" option on cryostat was used.
- Once the chuck was is in position, then manually the block was moved close to the cutting blade.

- The tissue was fully seen by using a trim setting on your cryostat; then an advance button was pressed each time before one full revolution of the instrument's wheel.
- As the tissue was cut, the tissue was anchored to prevent folding or curling; this was done by using a precooled paintbrush with stiff bristles and a wide gripping surface
- The brush was held like a pen with your left hand.
- The fifth finger was rested on the stage for stabilization
- The wheel was turned with right hand in a continuous motion without stopping.

RAPID HEMOTOXYLIN AND EOSIN STAINING:

- After obtaining frozen section, the slides were immediately fixed in 95% ethanol
- The slide was then dipped in 95% alcohol for 45 - 60 seconds followed by
  Water for 5 - 7 seconds
- Then the slide was stained with Hematoxylin for 60 seconds
- The slide was then washed with water and stained with Eosin for 20 - 60 seconds
- The slide was then dipped in 95% alcohol for 10 seconds followed by 100% alcohol for 10 seconds
- The slide was then dipped in Xylene for 10 seconds
- Then mounting media was added for cover slipping

TOLUDINE BLUE STAINING:

- The slide was dipped in 95% of alcohol and then stained with toludine blue for 1-2 minutes.
- Then the slide was washed in distilled water by 3 times.
- The slide then underwent dehydration quickly by the use of 95% alcohol and then 2 changes in100% alcohol.
- Then the slide was cleared in xylene solution 2 times.
- The slide was then covered by coverslip with resinous mounting medium.

IMPRINT CYTOLOGY PROCESSING:

The representative tissue was taken from the lesion and three imprint smears were be made by gently rolling the tissue on two glass slides. Two wet fixed smear were immediately fixed in 95% ethyl alcohol and stained with Haematoxylin and Eosin (H&E) stain and toluidine blue stain and one dried smear stained with May Grunwald Giemsa (MGG) stain.

RAPID HEMOTOXYLIN AND EOSIN STAINING:

- The slide were immediately fixed in 95% ethanol
- The slide was then dipped in 95% alcohol for 45 - 60 seconds followed by
  Water for 5 - 7 seconds
- Then the slide was stained with Hematoxylin for 60 seconds
- The slide was then washed with water and stained with Eosin for 20 - 60 seconds
- The slide was then dipped in 95% alcohol for 10 seconds followed by 100% alcohol for 10 seconds
- The slide was then dipped in Xylene for 10 seconds
- Then mounting media was added for cover slipping

TOLUDINE BLUE STAINING:

- The slide was dipped in 95% of alcohol and then stained with toludine blue for 1-2 minutes.
- Then the slide was washed in distilled water by 3 times.
- The slide then underwent dehydration quickly by the use of 95% alcohol and then 2 changes in100% alcohol.
- Then the slide was cleared in xylene solution 2 times.
- The slide was then covered by coverslip with resinous mounting medium.

GIEMSA STAINING:

- The slide was fixed with 95% alcohol and then stained with giemsa stain with 1:10 dilution for 10 minutes.

- Wash under running water for 10-15 seconds.
- Then after drying,mounting media was added for cover slipping.

PARAFFIN BLOCK TISSUE PROCESSING:

The tissue fixed in 10 % formalin was processed through a series of solutions in the automatic tissue processor as follows:

- Acid formalin for 4 hours
- Formal alcohol for 1 hour
- 80% ethyl alcohol for 1 hour
- 90% ethyl alcohol for 1 hour
- Absolute ethyl alcohol for 1 hour
- Acetone [1st change] for 1 hour
- Acetone [2nd change] for 1 hour
- Xylene [1st change] for 1 hour
- Xylene [2nd change] for 1 hour
- Paraffin [1st change at 58-69°C] for 1 hour
- Paraffin [2nd change at 58-69°C] for 1 hour

The paraffin embedded tissue blocks were cut at 2-3um thickness by rotary microtome. The sections were then transferred onto aluminized slides. These sections were labelled properly with the help of glass marking pencil.

HEMATOXYLIN AND EOSIN STAINING OF PARAFFIN BLOCK TISSUE:

- Slides were kept on hot plate in order to dewax the sections at temperature upto 60ºC.
- Then the slides were deparaffinised in xylene
- Then hydration was done by passing through descending rates of alcohol to water
- The slides were then stained in Harris Hematoxylin for 15 minutes.
- Sections were washed well in running tap water until sections turned blue.

- These sections were then differentiated in 1 % acid alcohol [1% HCL in 70% alcohol] for 5-10 seconds, washed well in tap water till sections were again blue for 5 minutes or less.
- These were again stained in 1% Eosin for 10 minutes followed by washing in running tap water for 1-5 minutes.
- Sections were dehydrated once again through ascending grades of alcohol, cleaned in xylene and mounted with DPX [Distyrenedibutylphtalate xylene] avoiding the air bubbles.
- Stained slides were then subjected to microscopic examinations under both low power [10X] and high power [40X]

OBSERVATIONS AND RESULTS

This study was conducted in the Department of Pathology at Dayanand Medical College and Hospital, Ludhiana over a period of 1 year prospectively from 15th September 2022 to 14th September 2023. All the fresh unfixed tissue specimens sent for frozen section examination with a specific indication were examined grossly and frozen sections from the representative areas were processed along with making 3 imprints were also made on glass slides. Imprint slides were stained with Toludine blue stain, Giemsa stain and Haemotoxylin stain. Frozen sectioning was done on cryostat and it was set at a temperature range depending upon the nature of the tissue. Sections were cut at a thickness of 4-6 micron and were immediately stained with rapid Haemotoxylin and Eosin (H&E) stain and Toludine blue stain. Imprint slides and frozen section slides were examined by 2 consultants each independently and a consensus was reached which was immediately conveyed to the operating surgeon. The time of receiving the specimen in the department and the time at which the imprint diagnosis and frozen section report was informed to the surgeon was noted for every case as it was a critical parameter.

Subsequently, the rest of the specimen was fixed in 10% of formalin which was then grossed and adequate representative sections were processed. The sections were then stained with haemotoxylin and eosin (H&E) stain. The results of both the techniques were compared to final histopathological diagnosis of paraffin fixed sections which was considered a gold standard and a detailed analysis was done.

In our study period we received a total of 281 specimens in our department which were analyzed.

Table 1-Age wise distribution [n=281]

Age group (in years)	No. of cases	Percentage
< 30	50	17.8%
31-40	68	24.2%
41-50	79	28.1%
51-60	61	21.7%
> 60	23	8.2%
Total	281	100.0%
Mean	53.2	
Range	20-80	

The commonest age group who underwent imprint cytological evaluation and frozen section were between 41 to 50 years comprising of 79 cases [28.1%] followed by 68 cases [24.2%] who were in the age group of 31 to 40 years. The least number of cases were in the age group of more than 60 years with 23 cases[8.2%]. The youngest patient was 20 years old while the eldest patient was 80 years old. Mean age was 53.2 years.

Table 2- Gender wise distribution [n=281]

Sex	No. of cases	Percentage
Female	226	80.4%
Male	55	19.6%
Total	281	100%

The overall frozen section and imprint cytology were performed more on surgical resections done on female patients constituting 226 cases [80.4%] with a male to female ratio of 1:4.1.

Table 3 – Indications for Intra-Operative assessment [n=281]

Nature of lesion	No. of cases	Percentage
Primary diagnosis	127	45.19%
Resected Margins	40	14.23%
Evidence of metastasis	108	38.4%
Infection	6	2.13%
Total	281	100%

Frozen section and imprint cytology were ordered in 127 cases [45.19%] for primary diagnosis, while in 108 cases [38.4%] they were done to look for evidence of metastasis, in 40 cases [14.23%] they were sent to assess the resected margin status and in 6 cases [2.13%] to look for infection. The term primary diagnosis meant to ascertain the nature of a lesion; whether neoplastic or nonneoplastic. If neoplastic then whether it is benign or malignant. Requisition was also sent to ascertain the resected margins status in malignant tumors. Another common indication for frozen section was to look for metastasis in various organs like lymph nodes, omentum and peritoneal biopsies.

Table 4-Type of specimen received for frozen section [n=281]

Type of Specimen	No. of cases	Percentage
Large	58	20.6%
Small	223	79.4%
Total	281	100.0%

Out of the total 281 specimens, 58 [20.6%] were large specimens and 223 specimens [79.4%] were small. Small specimens included any specimen of size less then 5 cm which included endometrial curettings,

resected margins, sentinel lymph nodes and suspected nodules of metastatic deposit. The large specimen included resection specimens like hysterectomies, cholecystectomies, appendicectomies, ovarian masses, parathyroidectomies, segment of intestine and large volume curretings.

Time taken for evaluation of imprint cytology and frozen section

This was a critical parameter in our study as our department is housed in the same building as the operation theatres. So the revert time was calculated from the time the specimen was received in our department to the time the report of frozen section was informed to the operating surgeon.

Table 5- Time taken for diagnosis-Imprint Cytology (minutes)

Time taken for diagnosis-Imprint Cytology (minutes)	No. of cases	Percentage
< 20	140	49.82
21-40	126	44.84
40-60	15	5.33
>60	0	0
Total	281	100.0
Mean	22.63 minutes	

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For imprint cytology, in 140 cases [49.82%] the reporting time was less than 20 minutes while in 126 cases [44.84%] the revert time was 21-40 minutes. In 15 cases [5.33%] , reporting time was more than 40 minutes out of which 4 were margins, 6 were lymph nodes, one was gall bladder, one was parathyroid gland, one was parotid gland and one was cervical biopsy. Mean time taken was 22.63 minutes. Least amount of time taken was 10 minutes. Maximum time taken was 48 minutes in 1 case.

Table 6- Time taken for diagnosis-Frozen section (minutes)

Time taken for diagnosis-Frozen section (minutes)	No. of cases	Percentage
< 20	10	3.6
21-40	197	70.1
41-60	66	23.5
> 60	8	2.8
Total	281	100.0
Mean	35.45 minutes	

For frozen section, in majority of the cases,i.e. 197 cases [70.1%] ,the revert time was between 20 to 40 minutes while in 66 cases [23.5%] the revert time was 41-60 minutes. In 10 cases [3.6%], revert time was less than 20 minutes but in 8 cases [2.8%], revert time was more than 60 minutes. Mean time taken was 35.45 minutes .Least time taken was 15 minutes. Maximum time taken was 77 minutes in 1 case of parathyroid adenoma in which there was suspicion of malignancy and opinion took longer time to do, but it was finally reported as Parathyroid adenoma.

Imprint Cytology and Frozen section Diagnostic categories

All the cases were categorized as neoplastic and non- neoplastic.

Non-neoplastic-They comprised of normal elements of organs such as endometrial stromal cells and glandular epithelial cells for endometrium, normal lining epithelium for margins and benign columnar epithelium for gall bladder specimens, infective lesions like granulomatous inflammation including tuberculosis, acute suppurative

pathology and reactive lesions like reactive hyperplasia of the lymph node along with endometriosis.

Neoplastic**–**This group included cases which were either benign neoplasms, suspicious for malignancy or malignant neoplasm. For imprint cytology, cytological features such as cells having high N/C ratio, nuclear pleomorphism, conspicuous nucleoli, irregular nuclear contours and scant amount of cytoplasm were included. For frozen section, architecture such as papillary, solid , nests and glandular pattern with cells exhibiting nuclear hyperchromasia ,pleomorphism and scant cytoplasm were included in this category.

Table 7- Imprint cytology report [n=281]

Imprint cytology report	**No. of Cases**	**Percentage**
Non-neoplastic	179	63.7%
Neoplastic	98	34.9%
Deferred	4	1.4%
Total	281	100%

Table 8 - Frozen section report [n=281]

Frozen section report	**No. of Cases**	**Percentage**
Non-neoplastic	182	64.8%
Neoplastic	96	34.2%
Deferred	3	1.0%
Total	281	100%

Table 9- Site of specimen [n=281]

Site of specimen	No. of cases	Percentage
Anterior Abdominal Cyst wall	1	0.4%
Bowel nodule	3	1.1%
Brain	2	0.7%
Breast lump	1	0.4%
Buccal mucosa	6	2.1%
Cervical lymph node	2	0.7%
Cervix	3	1.1%
Duodenum	1	0.4%
Endometrium	25	8.8%
Eyelid lesion	2	0.7%
Fibroid	3	1.1%
Fistula	1	0.4%
Gall bladder	14	5.0%
Hysterectomy specimen	3	1.1%
Knee joint	4	1.4%
Liver	3	1.1%
Lung tissue	1	0.4%
Mandible	1	0.4%
Surgical Margins	38	13.5%
Nose	1	0.4%
Omental nodule	3	1.1%
Ovary	43	15.3%
Parathyroid gland	10	3.5%
Parotid gland	3	1.1%
Scar site ectopic	1	0.4%
Sentinel lymph node	98	34.9%
Thigh	1	0.4%
Tongue	3	1.1%
Total gastrectomy specimen	2	0.7%
Urinary bladder	2	0.7%
Total	281	100.0%

Organ-wise distribution:

1. SENTINEL LYMPH NODES :[n=98]

Sentinel lymph node is defined as first extracutaneous target of lymphogenous tumor cell spread and potential source of subsequent lymph node metastases and distant metastases. In a sentinel lymph node biopsy, a tracer material is used to help the surgeon find the sentinel lymph nodes during surgery. Detection and pathologic examination of sentinel lymph node can potentially alter the extent and radicality of oncologic surgery. When sentinel lymph node shows presence of tumor, an immediate level 2 axillary clearance is indicated in breast cancers, however, a negative sentinel lymph node leads to the operation being curtailed.

Table 10- Age group wise distribution of patients with intraoperative evaluation of sentinel lymph nodes (in years)(n=98)

Age group	No. of cases	Percentage
< 30	13	13.3%
31-40	15	15.3%
41-50	39	39.8%
51-60	24	24.5%
> 60	7	7.1%
Mean	55.4 years	
Median	55 years	

The most common age group for which lymph nodes were received was 41-50 yrs of age which comprised of 39 cases [39.8%], followed by 51-60 yrs with 24 cases [24.5%], followed by 31-40 yrs with 15 cases [15.3%], followed by less than 30 yrs with 13 cases [13.3%] and the least common age group was more than 60 yrs which comprised of only 7 cases [7.1%].

Mean age was 55.4 years and median age was 55 years.

Table 11- Sex wise distribution of patients with intraoperative evaluation of sentinel lymph nodes(n=98)

Sex	No. of cases	Percentage
Female	97	99.0%
Male	1	1.0%
Total	98	100%

Out of 98 cases of lymph nodes received,97 [99.0%] were females where primary malignancy was breast carcinoma while only 1 case [1.0%] was a male where primary was thyroid carcinoma. Male to female ratio was 1:97.

Ninety seven cases were from sent where the primary was suspected to be breast carcinoma whereas in one case the primary was thyroid carcinoma.

Table 12- Time taken to diagnose imprint cytology for sentinel lymph nodes (n=98)

Imprint cytology time (in minutes)	No. of cases	Percentage
< 20	53	54.1%
21-40	39	39.8%
> 40	6	6.1%
Mean	22.7 minutes	
Median	20 minutes	

Table 13- Time taken to diagnose frozen section for sentinel lymph nodes (n=98)

Frozen section time (in minutes)	No. of cases	Percentage
< 20	2	2.0%
21-40	70	71.4%
41-60	20	20.4%
> 60	6	6.1%
Mean	35.9 minutes	
Median	34 minutes	

Time taken for diagnosis in case of imprint cytology was less than 20 minutes in majority of the cases i.e. 53 cases [54.1%] while for frozen section only 2 cases [2.0%] were diagnosed within 20 minutes. In case of frozen section, maximum cases were diagnosed between 21-40 minutes i.e. 70 cases [71.4%]. None of the case in case of imprint cytology took more than 60 minutes to diagnose but in case of frozen section ,6 cases [6.1%] took more than 60 minutes to diagnose. Hence, imprint cytology could become an efficient method of diagnosing metastasis in case of sentinel lymph nodes. The 6 cases which took more than 60 minutes in frozen section were those cases in which multiple lymph nodes were sent for the same patient.

Table 14: Diagnosis of sentinel lymph nodes on imprint cytology(n=98)

Diagnosis	Imprint cytology		Histopathology	
	Number of cases	Percentage	Number of cases	Percentage
Reactive hyperplasia	78	79.6%	76	77.5%
Suspicious for malignancy	1	1.02%	0	0%
Metastatic Carcinomatous deposits	19	19.38%	22	22.4%
Total	98	100%	98	100%

Out of 98 lymph nodes received, on imprint cytology, 78 cases [79.6%] were diagnosed as Reactive hyperplasia, 19 cases[19.38%] were diagnosed as Metastatic carcinomatous deposits and one case [1.02%] was diagnosed as suspicious for malignancy.

In case of Reactive hyperplasia, reactive lymphoid cells were seen in varying stages of maturation seen as immunoblasts, centroblasts and centrocytes. No atypical cells were noted.

In one case of Suspicious for malignancy, there were few scattered cells having high N/C ratio, fine chromatin, irregular nuclear contours and scant amount of cytoplasm,however, they were very few to make a diagnosis of malignancy.

In 19 cases [19.38%] which were reported Positive for malignancy-Metastatic carcinomatous deposits, cellular smears showed clusters of atypical cells with enlarged hyperchromatic nuclei, nuclear overlapping, prominent nucleoli and scant amount of cytoplasm against a background of reactive lymphoid cells.

In cases of Metastatic carcinomatous deposits, the N/C ratio was high in 20 cases [100%] with conspicuous nucleoli in 6 cases [31.5%] vesicular chromatin in 4 cases [21.05%]. Irregular nuclear contours were observed in 16 cases[84.2%]. Reactive germinal centres were also seen in 10 cases[52.6%].

Table 15- Diagnosis of sentinel lymph nodes on frozen section(n=98)

Diagnosis	Frozen section		Histopathology	
	No.of cases	Percentage	No. of cases	Percentage
Reactive hyperplasia	75	76.5%	76	77.5%
Suspicious for malignancy	1	1.02%	0	0%
Metastatic Carcinomatous deposits	22	22.44%	22	22.4%
Total	98	100%	98	100%

In case of frozen section, 75 cases [76.5%] were diagnosed as Reactive hyperplasia, 22 cases [22.44%] cases as Positive for malignancy and one case [1.02%] as Suspicious for malignancy.

Seventy five cases reported as reactive hyperplasia showed presence of maintained nodal architecture with lymphoid follicles and reactive germinal centres and sinuses were dilated and filled with histiocytes. However, no evidence of malignancy was seen.

Twenty two cases reported as metastatic carcinomatous deposits showed clusters of tumor cells arranged in nests and sheets. Individual tumor cells had hyperchromatic nuclei and moderate amount of cytoplasm.

One case diagnosed as Suspicious for malignancy showed few scattered cells having high N/C ratio, irregular nuclear contours and scant cytoplasm.

Table 16- Correlation of Imprint cytology and Frozen section with histopathology in Sentinel lymph nodes (n=98)

	Concordant with Histopathology	Percentage	Discordant with Histopathology	Percentage
Imprint cytology	92	93.8%	6	6.1%
Frozen section	97	98.9%	1	1.02%

To correlate frozen section and imprint cytology, the category of suspicious for malignancy was considered to be malignant- Metastatic carcinomatous deposits.

In case of imprint cytology,92 cases[93.8%] were concordant with histopathology and 6 cases [6.1%] were discordant.

In case of frozen section,97 cases [98.9%] cases were concordant with histopathology and 1 case [1.02%] was discordant.

Table 17- Discordant cases on Imprint cytology of Sentinel lymph nodes [n=6]

Diagnosis on Imprint cytology	**Diagnosis on Histopathology**	**Reason for discordance**
Suspicious for malignancy(1)	Reactive hyperplasia(1)	Technical error
Reactive hyperplasia(4)	Metastatic carcinomatous deposits(4)	Sampling error
Metastatic carcinomatous deposits(1)	Reactive hyperplasia(1)	Interpretation error

Out of the 6 discordant cases, 1 case reported as Suspicious for malignancy on touch imprints was diagnosed Reactive hyperplasia on histopathology, reason being technical error.

One case which was reported as Metastatic carcinomatous deposits on imprint cytology was diagnosed as Reactive hyperplasia on final diagnosis as the cells appeared larger on imprints.

Four cases which were reported as Reactive hyperplasia on Imprint cytology were reported as Metastatic carcinomatous deposits, the reason for discordance being sampling error in those 4 cases due to non-representative sampling.

Discordant case on Frozen section of SENTINEL LYMPH NODES (1 case)

Only one case which was reported as Suspicious for malignancy on frozen section, was reported as Reactive hyperplasia because of misinterpretation of the cells which appeared crushed, hyperchromatic and enlarged on frozen section.

Sensitivity, specificity, PPV, NPV rate of Sentinel lymph nodes on imprint cytology

True positive: 18/98

True negative: 74/98

False positive: 2/98

False negative: 4/98

1) **Sensitivity**: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{18}{18+4} \times 100 = 81.8\%$

2) **Specificity**: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{74}{74+2} \times 100 = 97.3\%$

3) **PPV:** $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{18}{18+2} \times 100 = 90\%$

4) **NPV:** $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{74}{74+4} \times 100 = 94.8\%$

5) **P-value:** 0.001, hence significant.

Sensitivity, specificity, PPV, NPV rate of Sentinel lymph nodes on frozen section

True positive: 22/98

True negative: 75/98

False positive: 1/98

False negative: 0/98

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{22}{22+0} \times 100 = 100\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{75}{75+1} \times 100 = 98.6\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{22}{22+1} \times 100 = 95.6\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{75}{75+0} \times 100 = 100\%$

5) P-value: 0.001, hence significant.

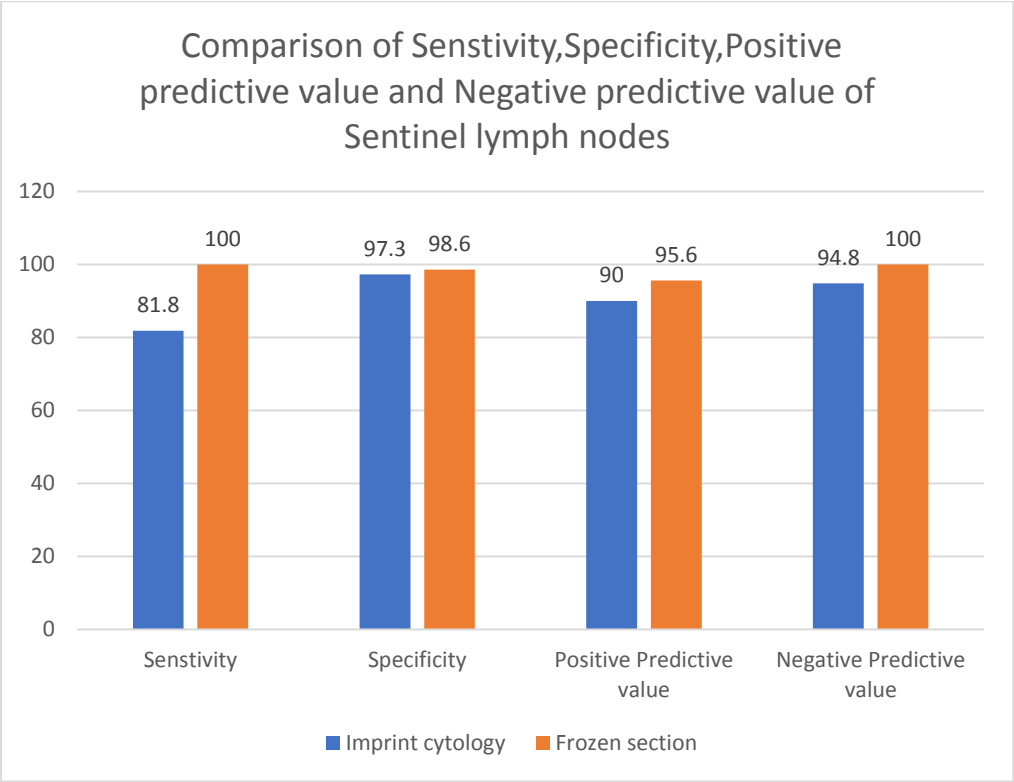

Figure No. 1: Comparison of Sensitivity, Specificity, Positive predictive value and Negative predictive value of Sentinel lymph nodes

In case of Sentinel lymph nodes, diagnostic efficacy of frozen section was better than imprint cytology as it showed higher concordance rate than imprint cytology.

2 .OVARY [n=44]

44 cases from the ovary were received to ascertain the primary diagnosis.

Table 18- Age group distribution of patients with ovarian resections or biopsies (in years) (n=44)

Age group	No. of cases	Percentage
< 30	17	38.6%
31-40	14	31.8%
41-50	5	11.4%
51-60	8	18.2%
> 60	0	0.0%
Mean	44.3 years	
Median	43 years	

The most common age group for which ovarian resections or biopsies were received was less than 30 years comprising of 17 cases [38.6%], followed by 31-40 yrs with 14 cases [31.8%], 51-60 yrs with 8 cases [18.2%], 41-50 yrs with 5 cases [11.4%] and none of the cases were received above 60 years of age.

Table 19- Type of specimen received for ovarian resections or biopsies [n=44]

Type of Specimen	No. of cases	Percentage
Large	34	77.3%
Small	10	22.7%
Total	44	100%

Out of the 44 specimens received for primary diagnosis, 34 specimens [77.3%] were large and 10 specimens [22.7%] were small in size. One of the large specimens was received as hysterectomy specimen.

Table 20- Time taken to diagnose imprint cytology for ovarian specimens (n=44)

Imprint cytology time (in minutes)	No. of cases	Percentage
< 20	21	47.7%
21-40	22	50%
> 40	1	2.3%
Mean	22.6 minutes	
Median	21 minutes	

In the case of imprint cytology, 21 cases [47.7%] were diagnosed within 20 minutes, 22 cases [50%] were diagnosed between 21-40 minutes and only 1 case [2.3%] took more than 40 minutes to diagnose because it was a large specimen and there was a lot of inflammatory infiltrate in the background which came from hemorrhagic fluid on cut section.

Table 21- Time taken to diagnose frozen section for ovarian specimens (n=44)

Frozen section time (in minutes)	No. of cases	Percentage
< 20	2	4.5%
21-40	29	65.9%
41-60	13	29.5%
> 60	0	0.0%
Mean	34.9 minutes	
Median	34 minutes	

In case of frozen section, 29 cases [65.9%] took 21-40 minutes to diagnose,13 cases [29.5%] took 41-60 minutes to diagnose and 2 cases [4.5%] took less than 20 minutes to diagnose.

Table 22- Diagnosis of ovarian resections or biopsies on imprint cytology(n=44)

Diagnosis	No. of cases	Percentage
Non-Neoplastic	22	50%
Neoplastic	22	50%
Deferred	0	0

Among 44 cases,22 cases [50%] were non-neoplastic and 22 cases [50%] were neoplastic on imprint cytology.

Table 23- Non neoplastic cases in ovarian resections or biopsies [n=22]-IMPRINT CYTOLOGY

Diagnosis	No. of cases	Percentage
Normal elements	11	50%
Endometriosis	4	18.2%
Non-neoplastic, NOS	7	31.82%

Out of 22 non neoplastic cases, majority of the cases i.e. 11 cases [50%] were diagnosed as normal elements with no evidence of malignancy; followed by Non-neoplastic, NOS, 7 cases [31.82%] having presence of scattered stromal cells and foamy macrophages and hemorrhage and 4 cases [18.2%] as endometriosis because of presence of many hemosiderin laden macrophages.

Table 24-Comparative analysis of Non- Neoplastic diagnosis of ovarian resections or biopsies using various modalities [n=22]

Imprint cytology	Frozen section	Histopathology	Percentage
Normal elements (11)	Normal elements (7)	Normal elements (6)	27.27%
		Endometriosis (1)	4.54%
	Endometriosis (2)	Endometriosis (1)	9.09%
		Serous cystadenoma (1)	4.54%
	Non-neoplastic,NOS (2)	Endometriosis (1)	4.54%
		Serous cystadenoma (1)	4.54%
Endometriosis (4)	Endometriosis (4)	Endometriosis (4)	18.2%
Non-neoplastic, NOS (7)	Hemorrhagic cyst (2)	Hemorrhagic cyst (2)	9.09%
	Mature cystic teratoma (1)	Mature cystic teratoma (1)	4.54%
	Non-neoplastic, NOS (4)	Simple cyst (1)	4.54%
		Endometriosis (1)	4.54%
		Benign cystic lesion (1)	4.54%
		Serous cystadenofibroma (1)	4.54%

Out of 22 non- neoplastic cases of ovary on imprint cytology, 6 [27.27%] cases were diagnosed as normal elements both on frozen section and histopathology, hence concordant. One case [4.54%] diagnosed as normal elements on imprint cytology and frozen section showed features of Endometriosis on histopathology and hence was discordant on histopathology. Two cases [9.09%] showing only normal

elements on imprint cytology were diagnosed as Endometriosis on frozen section and were further diagnosed as Endometriosis and Serous cystadenoma on histopathology, respectively. In case Endometriosis on frozen section were seen Endometrial glands and stroma with hemosiderin laden macrophages with similar findings in histopathology. Histopathology of Serous cystadenoma showed cyst lined by tall columnar ciliated cells layer with little fibroblastic stroma and non branching papillae. Hence both these cases of imprint cytology were discordant with histopathology whereas one case of these turned out to be concordant on frozen section with histopathology while the other remained discordant. Two cases [9.09%] showing normal elements on imprint cytology were diagnosed as Non-neoplastic ,NOS exhibiting stromal cells and foamy macrophages on frozen section and were later finally diagnosed as Endometriosis and Serous cystadenoma respectively, on histopathology. Hence whereas both these cases of imprint cytology were also discordant with final histopathology and only one case of Non-neoplastic, NOS remained discordant on frozen section with histopathology.

Four cases [18.2%] diagnosed as Endometriosis on imprint cytology and showed scattered endometrial cells and numerous hemosiderin laden macrophages which on frozen section and histopathology showed cysts lined by endometrial lining epithelium beneath which were seen endometrial glands and stroma with hemosiderin laden macrophages and were diagnosed as Endometriosis, thus concordant.

Out of seven cases [31.81%] diagnosed as Non-neoplastic, NOS on Imprint cytology, two cases [9.09%] were diagnosed as Hemorrhagic cyst on frozen section and histopathology seen as cyst lined by inner layer of granulosa cells and outer layer of theca cells with areas of hemorrhage, hence concordant; one case [4.54%] was diagnosed as Mature cystic teratoma both on histopathology and frozen section and showed presence of hair follicles, areas of squamous lining epithelium and keratin. Hence although concordance was seen between frozen section and histopathology, it was discordant on imprint cytology.

Four cases [18.25%] diagnosed as Non-neoplastic, NOS on imprint cytology and frozen section both were diagnosed as Simple cyst [4.54%] showing lining of simple squamous epithelium, Endometriosis [4.54%] seen as cysts lined by endometrial lining epithelium beneath which were seen endometrial glands and stroma with hemosiderin laden macrophages, Benign cystic lesion [4.54%] having lining of cuboidal epithelium with no branching and Serous cystadenfibroma [4.54%] on histopathology. Serous cystadenofibroma was seen as cyst lined by tall columnar ciliated cells layer with prominent fibroblastic stroma and non branching papillae. Thus one case of Non-neoplastic, NOS which was diagnosed as Serous cystadenofibroma was both discordant with imprint cytology and frozen section.

Table 25-Diagnosis of Neoplastic cases of ovarian resections or biopsies on Imprint cytology [n=22]

Diagnosis on Imprint cytology	**Percentage**
Benign (3)	13.63%
Malignant (6)	27.27%
Neoplasm (13)	59.09%

Three cases [13.63%] were categorised as Benign, 7 cases [31.81%] as Malignant and 12 cases [54.54%] as Neoplasm on Imprint cytology.

Table 26- Diagnosis of Neoplastic cases of ovarian resections or biopsies [n=22]

Imprint cytology		Frozen section	Histopathology
Categories	**Diagnosis**	**Diagnosis**	**Diagnosis**
Benign (3)	Surface Epithelial tumor (2)	Surface Epithelial tumor (2)	Serous cystadenofibroma (2)
	Dermoid cyst (1)	Dermoid cyst (1)	Dermoid cyst (1)
Malignant (6)	Carcinoma (6)	Carcinoma (4)	Endometrioid carcinoma (3)
			High grade carcinoma (1)
		Borderline surface epithelial tumor (2)	Endometrioid carcinoma (1)
			Low grade serous carcinoma (1)
Neoplasm (13)	Mucinous Neoplasm (8)	Mucinous Carcinoma (1)	Mucinous Adenocarcinoma (1)
		Normal elements (1)	Mucinous Adenocarcinoma (1)
		Mucinous neoplasm (6)	Mucinous cystadenoma (5)
			Mucinous borderline tumor (1)
	Spindle cell Neoplasm(4)	Stromal tumor (4)	Thecoma (1)
			Fibroma (1)
			Granulosa cell tumor (1)
			Sex cord stromal tumor (1)
	Papillary Neoplasm (1)	Borderline serous tumor (1)	Adenocarcinoma, possibly serous (1)

Out of 3 benign cases, 2 cases were diagnosed as Surface epithelial tumor on Imprint cytology seen as small clusters of benign round to cuboidal epithelial cells showing honeycombing,with uniform nuclei and pale chromatin. On frozen section diagnosis of Benign surface epitheial tumor was given and showed small unilocular cysts lined by single layer of tall cuboidal epithelium with fibrotic stroma. These two cases were diagnosed as Serous cystadenofibroma on histopathology seen as cyst lined by tall columnar ciliated cells layer with prominent fibroblastic stroma and non branching papillae, and were concordant. One case diagnosed as Dermoid cyst on Imprint cytology seen as anucleate squames, benign columnar cells, macrophages in a background of thick amorphous material which on frozen section and histopathology showed presence of squamous epithelium, hair follicles and bits of cartilage was diagnosed as Dermoid cyst. All cases were concordant.

Out of 6 malignant cases, all 6 cases were diagnosed as Carcinoma on Imprint cytology seen as nests and clusters of cells with high N/C ratio,hyperchromatic nuclei and scant cytoplasm. Out of these 6 cases, 4 cases were diagnosed as Carcinoma on frozen section seen as cells arranged in glandular configuration which were further diagnosed as Endometrioid carcinoma (3 cases) seen as back to back arranged glands lined by cells exhibiting marked nuclear hyperchromasia and pleomorphism with evidence of invasion; High grade carcinoma (1 case) on histopathology. 2 cases diagnosed as Borderline Surface epithelial tumor on frozen section seen as numerous bulbous papillae with fibrous cores with hierarchical branching pattern lined by cuboidal epithelium with mild nuclear atypia were diagnosed as Endometrioid carcinoma and Low grade serous carcinoma on histopathology. All 6 diagnosis of imprint cytology were concordant with histopathology but two Borderline Surface epithelial tumor diagnosis on frozen section were discordant with histopathological diagnosis as it is very difficult to give diagnosis of carcinoma on frozen section when invasive focus is not sampled.

Out of 12 cases categorised as Neoplasm, 8 cases were diagnosed as Mucinous neoplasm on Imprint cytology seen as columnar cells with basally located nuclei having abundant vacuolated cytoplasm seen as honeycombs against a mucinous background. Out of these 8 Mucinous neoplasms, 6 cases were diagnosed as Mucinous neoplasm on frozen section seen as cystic neoplasm with cysts and glands lined by single layer of bland mucinous epithelium out of which 5 cases turned out to be Mucinous cystadenoma seen as cystic neoplasm with cysts and glands lined by single layer of bland mucinous epithelium and one as Mucinous borderline tumor seen as complex architecture with tufting and villi formation lined by cells with crowding,stratification and mitosis,on histopathology. Thus all 6 imprint and frozen diagnosis were concordant with histopathological diagnosis. Seventh case was diagnosed as Mucinous carcinoma seen as complex glands and solid pattern lined by neoplastic cells exhibiting marked nuclear pleomorphism with stromal invasion and areas of necrosis on both frozen section and histopathology, hence it was also concordant. The last case was diagnosed as normal elements on frozen section and finally turned out to be Mucinous adenocarcinoma on histopathology and thus frozen diagnosis was found discordant with histopathology, reason being sampling error, although imprint diagnosis was concordant.

Four cases were diagnosed as Spindle cell neoplasm on imprint cytology seen as spindle cells which were scattered with plump nuclei and mild atypia; all 4 were further diagnosed as Stromal tumor on frozen section seen as cells with spindled to oval nuclei on frozen section which were finally proved to be thecoma with predominant population of cells with ovoid nuclei and grey cytoplasm; fibroma seen as variably sized cellular fascicles having bland spindled to ovoid nuclei with pointed ends and scant cytoplasm and present in abundant collagenous stroma; Adult granulosa cell tumor arranged in trabecular pattern with cuboidal to polygonal cells having angulated and grooved

nuclei and scant cytoplasm and Sex cord stromal tumor on histopathology and all were found concordant on all three modalities.

One case diagnosed as papillary neoplasm on imprint cytology having papillaroid clusters and papillae of cells lined by cuboidal epithelium exhibiting nuclear pleomorphism and conspicuous nuclei in few was diagnosed as Borderline serous tumor on frozen section as invasive focus was not found and Adenocarcinoma, possibly serous seen as hierarchical papillary branching having cells exhibiting significant nuclear atypia and pleomorphism with bizzare nuclei on histopathology Thus this case was discordant with histopathology on frozen section but concordant with imprint cytology.

All the cases of ovary labelled as Neoplastic on imprint cytology were concordant with histo-pathological diagnosis.

Table 27-Discordant Non- neoplastic cases of ovarian resections or biopsies on Imprint cytology [n=7]

Diagnosis on Imprint cytology	**Diagnosis on Histopathology**	**Reason for discordance**
Normal elements (5)	Endometriosis (3)	Sampling error
	Serous cystadenoma (2)	Sampling error
Non-neoplastic, NOS (2)	Mature cystic teratoma (1)	Sampling error
	Serous cystadenofibroma (1)	Sampling error

Five cases diagnosed as normal elements on imprint cytology were diagnosed as Endometriosis in 3 cases and Serous cystadenoma in 2 cases on histopathology because of sampling error as representative area could not be sampled.

Two cases diagnosed as Non-neoplastic, NOS on Imprint cytology were diagnosed as Mature cystic teratoma and Serous cystadenofibroma on histopathology because non representative area was sampled while making slides.

Table 28-Discordant cases of ovarian resections or biopsies on Frozen section [n=8]

Non- neoplastic cases	**Diagnosis on Histopathology**	**Reason for discordance**
Normal elements (1)	Endometriosis (1)	Sampling error
Endometriosis (1)	Serous cystadenoma (1)	Sampling error
Non-neoplastic, NOS (2)	Serous cystadenoma (1)	Sampling error
	Serous cystadenofibroma (1)	Sampling error
Neoplastic cases		
Borderline Surface epithelial tumor (2)	Endometrioid carcinoma (1)	Sampling error
	Low grade serous carcinoma (1)	
Normal elements (1)	Mucinous Adenocarcinoma (1)	Sampling error
Borderline serous tumor (1)	Adenocarcinoma, possibly serous (1)	Required more sampling

One case diagnosed as Endometriosis, Serous cystadenoma in two cases and Serous cystadenofibroma in one case on histopathology were diagnosed as normal elements, Endometriosis and Non-neoplastic, NOS on frozen section, all due to sampling errors.

Two cases diagnosed as Borderline surface epithelial tumors on frozen section were finally diagnosed as Endometrioid carcinoma and Low grade serous carcinoma on histopathology as invasive focus was not found on single section while doing frozen section and hence multiple sections are required.

One case diagnosed as Normal elements along with mucin on frozen section was diagnosed as Mucinous adenocarcinoma due to sampling error.

One case diagnosed as Borderline serous tumor on frozen section showed no invasive focus was diagnosed as Adenocarcinoma, possibly serous on histopathology.

Table 29- Correlation of Imprint cytology and Frozen section with histopathology in ovarian resections or biopsies (n=44)

	Concordant with Histopathology	Percentage	Discordant with Histopathology	Percentage
Imprint cytology	37	84.09%	7	15.9%
Frozen section	36	81.81%	8	18.18%

Out of the 44 cases, in case of imprint cytology,37 cases [84.09%] were concordant with histopathology and 7 [15.9%] cases were discordant with histopathology.

In case of Frozen section,36 cases[81.81%] cases were concordant with histopathology while 8 cases[18.18%] were discordant.

Sensitivity, specificity, PPV, NPV rate for ovarian resections or biopsies on imprint cytology

True positive: 22 /44

True negative: 18/44

False positive: 0/44

False negative: 4/44

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{22}{22+4} \times 100 = 84.61\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{18}{18+0} \times 100 = 100\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{22}{22+0} \times 100 = 100\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{18}{18+4} \times 100 = 81.81\%$

5) P-value: 0.001, hence significant.

Sensitivity, specificity, PPV, NPV rate for Ovary on frozen section

True positive: 21/44

True negative: 19/44

False positive: 0/44

False negative: 4/44

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{21}{21+4} \times 100 = 84\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{19}{19+0} \times 100 = 100\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{21}{21+0} \times 100 = 100\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{19}{19+4} \times 100 = 82.6\%$

5) P-value: 0.001, hence significant.

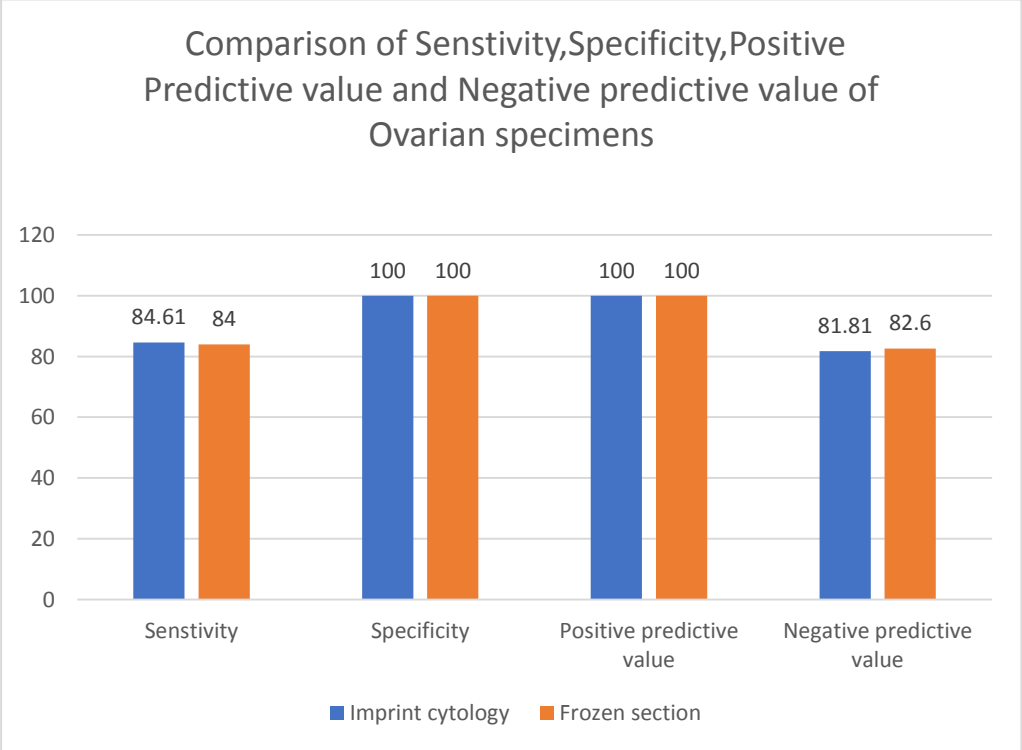

Figure No. 2: Comparison of Sensitivity, Specificity, Positive Predictive value and Negative predictive value of Ovarian specimens

In case of intraoperative assessment of ovarian lesions, imprint cytology was found to be marginally superior in sensitivity. The specificity and positive predictive value were 100% in both.

3. SURGICAL MARGINS (n=40)

Tissue for intraoperative examination of Margin status was sent for ureteric margins (14 cases) during cystectomy, eyelid margins (6 cases) during eyelid lesion excisions, total gastrectomy margins (4 cases), pancreatic margins (3 cases) during Whipple surgery, rectal margins(1case) for rectal carcinoma, cystic duct margins(3 cases), bile duct margins (1 case), hepatic duct margin (3 cases) in case of cholangiocarcinoma, proximal and distal margins (2 cases) for cholangiocarcinoma, scalp margin (1 case) for scalp lesion, esophageal margin(1 case) for carcinoma stomach and femur margin (1 case) for osteosarcoma.

Table 30- Age group distribution of patients with intraoperative margin assessment (in years) (n=40)

Age group	No. of cases	Percentage
< 30	6	15%
31-40	5	12.5%
41-50	12	30%
51-60	7	17.5%
> 60	10	25%
Mean	57.5 years	
Median	60 years	

The most common age group for which margins were received was 41-50 yrs with 12 cases[30%],followed by 10 cases[25%] in more than 60 age group, 7 cases[17.5%] in age group of 51-60 years, 6 cases [15%] in less than 30 yrs and 5 cases[12.5%] in 31-40 age group.

Table 31- Sex distribution of patients with intraoperative margin assessment (n=40)

Sex	**No. of cases**	**Percentage**
Female	14	35%
Male	26	65%
Total	40	100%

Out of 40 cases of margin status received,26 [65%] were males and 14 cases [35%] were females. Male to female ratio was 1.85:1.

Table 32- Time taken to diagnose imprint cytology for surgical margin assessment (n=40)

Imprint cytology time (in minutes)	No. of cases	Percentage
< 20	14	35%
21-40	22	55%
> 40	4	10%
Mean	23.9 minutes	
Median	24 minutes	

Maximum cases i.e. 22 cases [55%] to diagnose imprint cytology ranged between 21-40 minutes ,followed by less than 20 minutes for 14 cases [35%] and 4 cases[10%] took more than 40 minutes to diagnose.

Table 33- Time taken to diagnose frozen section for surgical margin assessment (n=40)

Frozen section time (in minutes)	No. of cases	Percentage
< 20	3	7.5%
21-40	25	62.5%
41-60	12	30%
> 60	0	0.0%
Mean	37.05 minutes	
Median	36 minutes	

In case of frozen section, 25 cases [62.5%] took 21-40 minutes to diagnose,12 cases [30%] took 41-60 minutes to diagnose, and only 3 cases [7.5%] took less than 20 minutes to diagnose.

Table 34- Diagnosis of intraoperative margin assessment on imprint cytology(n=40)

Diagnosis	Imprint cytology		Histopathology	
	No. of cases	Percentage	No. of cases	Percentage
Negative for malignancy	35	87.5%	39	97.5%
Suspicious for malignancy	4	10%	0	0%
Positive for malignancy	1	2.5%	1	2.5%
Total	40	100%	40	100%

Out of 40 cases which came for diagnosis, 35 cases [87.5%] were negative for malignancy on imprint cytology, 4 cases [10%] were suspicious for malignancy as few of the cells showed nuclear enlargement and hyperchromasia. One case [2.5%] was diagnosed as positive for malignancy and showed clusters and scattered atypical cells with high N/C ratio, irregular nuclear contours, fine chromatin and scant cytoplasm.

Table 35- Diagnosis of intraoperative margin assessment on frozen section (n=40)

Diagnosis	Frozen section		Histopathology	
	No. of cases	Percentage	No. of cases	Percentage
Negative for malignancy	37	92.5%	39	97.5%
Suspicious for malignancy	2	5%	0	0%
Positive for malignancy	1	2.5%	1	2.5%
Total	40	100%	40	100%

In case of imprint cytology, 37 cases [92.5%] were diagnosed as negative for malignancy, 2 cases [5%] were diagnosed as suspicious for malignancy and one case [2.5%] was diagnosed as positive for malignancy.

Table 36-Correlation of Imprint cytology and Frozen section with histopathology in margin status (n=40)

	Concordant with Histopathology	Percentage	Discordant with Histopathology	Percentage
Imprint cytology	36	90%	4	10%
Frozen section	38	95%	2	5%

Out of the 40 cases reported on Imprint cytology, 36 cases [90%] showed concordance with histopathology while 4 cases [10%] showed discordance.

Out of these 40 cases when reported on frozen section, 38 cases[95%] showed concordance with histopathology while 2 cases [5%] showed discordance.

Discordant cases on IMPRINT CYTOLOGY of INTRAOPERATIVE MARGIN ASSESSMENT (4 cases)

Four cases which were reported suspicious for malignancy on imprint cytology were reported negative for malignancy on histopathology because while making imprints, some cells due to streaking effect, crushed cells, and thick clusters made it hard to properly visualize individual cell morphology.

Discordant cases on FROZEN SECTION of INTRAOPERATIVE MARGIN ASSESSMENT (2 cases)

Two cases which were diagnosed as suspicious for malignancy had few scattered cells with nuclear hyperchromasia on frozen section and were labelled negative for malignancy on final histopathology.

Sensitivity, specificity, PPV, NPV rate of Margin assessment on imprint cytology

True positive: 1/40

True negative: 35/40

False positive: 4/40

False negative: 0/40

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{1}{1+0} \times 100 = 100\%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{35}{35+4} \times 100 = 89.7\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{1}{1+4} \times 100 = 20\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{32}{32+0} \times 100 = 100\%$

5) P-value: 0.008, hence significant.

Sensitivity, specificity, PPV, NPV rate of Margin assessment on frozen section

True positive: 1/40

True negative: 37/40

False positive: 2/40

False negative: 0/40

1)Sensitivity: True positive / True positive + False negative x 100 = 1 / 1+0 x 100 = 100 %

2)Specificity: True negative / True negative + False positive x 100 = 37 / 37+2 x 100 = 94.87%

3)PPV: True positive / True positive+ false positive x 100 = 1 / 1+2 x 100 = 33.3%

4)NPV: True negative / True negative+ false negative x 100 = 37 / 37+0 x 100 = 100%

5) P-value: 0.001, hence significant.

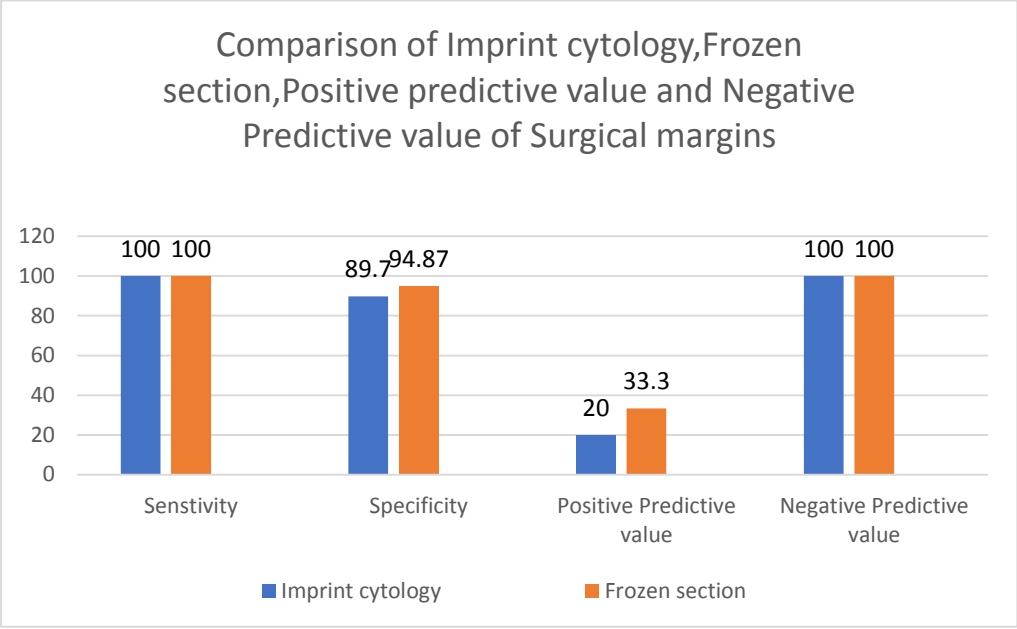

Figure No. 3: Comparison of Sensitivity, Specificity, Positive predictive value and Negative Predictive value of surgical margins

In case of surgical margin assessment, sensitivity and negative predictive value were similar in both the modalities whereas specificity and positive predictive value were better for frozen section.

4. ENDOMETRIUM (n=27)

Endometrial tissue was sent to know the primary diagnosis.

Table 37- Age group distribution of patients with intraoperative pathology examination of endometrium (in years)(n=27)

Age group	No. of cases	Percentage
< 30	1	3.7%
31-40	12	44.4%
41-50	9	33.3%
51-60	4	14.8%
> 60	1	3.7%
Mean	52.8 years	
Median	50 years	

Out of 27 cases,12 cases [44.4%] were from 31-40 age group, 9 cases [33.3%] from 41-50 age group, followed by 4 cases [14.8%] in 51-60 age group and one case each [3.7%] in less than 30 age group and more than 60 age group.

Table 38- Type of specimen received for frozen section for endometrium [n=27]

Type of Specimen	No. of cases	Percentage
Large	5	18.5%
Small	22	81.5%
Total	27	100%

Out of 27 cases, 22 specimens [81.5%] were small, whereas 5 specimens [18.5%] were large. Out of the 5 large specimens 2 were hysterectomy specimens.

Table 39- Time taken to diagnose imprint cytology for endometrium(n=27)

Imprint cytology time (in minutes)	No. of cases	Percentage
< 20	8	29.6%
21-40	19	70.4%
> 40	0	0%
Mean	23.4 minutes	
Median	23 minutes	

In case of imprint cytology, out of 27 cases, 8 cases [29.6%] were diagnosed in less than 20 minutes in case of imprint cytology and 19 cases [70.4%] were diagnosed between 21-40 minutes.

Table 40- Time taken to diagnose frozen section for endometrium (n=27)

Frozen section time (in minutes)	No. of cases	Percentage
< 20	0	0%
21-40	19	70.4%
41-60	8	29.6%
> 60	0	0.0%
Mean	34.9 minutes	
Median	34 minutes	

In case of frozen section, 19 cases[70.4%] were diagnosed within 21-40 minutes and 8 cases [29.6%] took 41-60 minutes to diagnose.

Table 41- Diagnosis of endometrium on imprint cytology(n=27)

Diagnosis	No. of cases	Percentage
Non neoplastic	16	59.25%
Neoplastic	9	33.33%
Deferred	2	7.41%
Total	27	100%

Sixteen cases [59.25%] were diagnosed as non-neoplastic while 9 cases [33.33%] as neoplastic on imprint cytology. Non-neoplastic cases included cases showing normal endometrial and stromal cells along with areas of hemorrhage. Neoplastic cases included cases diagnosed as Suspicious for malignancy in which few of the cells appeared enlarged and hyperchromatic, cases diagnosed as Malignant neoplasm showing neoplastic cells in clusters exhibiting nuclear enlargement and atypia.

Two [7.41%] cases were deferred due to insufficient cellularity.

Table 42- Diagnosis of endometrium on Frozen section(n=27)

Diagnosis	No. of cases	Percentage
Non neoplastic	20	74.07%
Neoplastic	6	22.2%
Deferred	1	3.7%
Total	27	100%

Out of 27 cases, 20 cases [74.07%] were Non-neoplastic whereas 6 cases [22.2%] were neoplastic and one case [3.7%] was deferred in frozen section. Non-neoplastic cases included cases showing normal endometrial glands and stroma with no features of malignancy and case of Benign endometrial polyp. Neoplastic cases included cases diagnosed as Endometrioid carcinoma with tumor cells arranged in glandular architecture exhibiting marked nuclear pleomorphism and hyperchromasia and Malignant neoplasm having tumor cells arranged in glands with cells showing loss of polarity, hyperchromasia and scant cytoplasm.

Table 43-Diagnosis of Non- Neoplastic cases of endometrium and deferred cases on imprint cytology [n=18]

Diagnosis on Imprint cytology	Diagnosis on frozen section	Diagnosis on histopathology	Percentage
Normal elements(15)	Normal elements(14)	Normal elements(15)	83.3%
	Deferred(1)		
Benign endometrial lesion (1)	Benign endometrial polyp (1)	Benign endometrial polyp (1)	5.55%%
Deferred cases (2)	Normal elements (2)	Normal elements (2)	11.11%

Out of 16 non neoplastic cases, 15 cases [93.7%] on imprint cytology showed normal elements with endometrial cells and stromal cells which was concordant with histopathology while one case on frozen section was deferred due to insufficient cellularity and hence was discordant with histopathology.

One case [6.6%] diagnosed as Benign endometrial lesion on imprint cytology was diagnosed as Benign endometrial polyp on both frozen section and histopathology and showed a polypoidal structure lined by epithelium on three sides having fibrovascular core and beneath which were present cystically dilated glands within fibrotic stroma and thickened blood vessels, thus concordant.

Two [11.11%] cases which were deferred on imprint cytology due to insufficient cellularity and hemorrhage only were diagnosed as normal elements on both frozen section and histopathology.

Table 44- Neoplastic cases in endometrium[n=9]

Diagnosis on Imprint cytology	Diagnosis on frozen section	Diagnosis on histopathology	Percentage
Suspicious for malignancy (3)	Normal elements(1)	Benign endometrial polyp(1)	11.11%
	Endometrial hyperplasia (2)	Normal elements (1)	11.11%
		Benign endometrial polyp (1)	11.11%
Malignant neoplasm (3)	Malignant neoplasm (3)	Leiomyosarcoma (1)	11.11%
		High grade malignant neoplasm (1)	11.11%
		Carcinosarcoma (1)	11.11%
Carcinoma (3)	Endometrioid carcinoma (3)	Endometrioid carcinoma (2)	22.22%
		Carcinosarcoma (1)	11.11%

Out of 9 cases of endometrium on imprint cytology,3 cases were diagnosed as Suspicious for malignancy on imprint cytology, due to improper smear making which were misinterpreted as tumor cells and hence discordant with histopathology. Out of these 3 cases, one case was diagnosed as normal elements on frozen section which was further diagnosed as Benign Endometrial polyp on histopathology seen as polypoidal structure lined by epithelium on three sides having fibrovascular core and beneath which were present cystically dilated glands within fibrotic stroma, hence, discordant. Two cases were diagnosed as Endometrial hyperplasia on frozen section were seen as

closely packed glands with gland to stroma ratio >3:1 with presence cystically dilated glands lined by columnar cells on frozen section which were further diagnosed as normal elements and Benign endometrial polyp on histopathology and hence discordant with histopathology.

Three cases were diagnosed as Malignant neoplasm on imprint cytology were seen as clusters of pleomorphic cells with high N/C ratio, fine chromatin and scant cytoplasm which were further diagnosed as Malignant neoplasm on frozen section seen as glands and papillae of cells with pleomorphic nuclei, conspicuous nucleoli in few along with few elongated spindle shaped cells exhibiting pleomorphism and scant amount of cytoplasm. One of these cases was diagnosed as Leiomyosarcoma on histopathology seen as tumor arranged in intersecting fascicles composed of pleomorphic spindle shaped cells with plump blunt ended nuclei and moderate amount of eosinophilic cytoplasm with marked hypercellularity and mitotic figures ,second case as High grade malignant neoplasm and third as Carcinosarcoma composed of epithelial and sarcomatous component seen as malignant glands and stroma with areas off necrosis and brisk mitosis on histopathology. Hence these three cases were concordant with histopathology both on imprint cytology and frozen section.

Three cases diagnosed as Carcinoma composed of clusters of pleomorphic cells with high N/C ratio, conspicuous nucleoli and scant amount of cytoplasm on imprint cytology were diagnosed as Endometrioid carcinoma on frozen section seen as back to back arranged glands lacking intervening stroma with complex papillae formation along with marked nuclear atypia,nuclear enlargement and evidence of stromal invasion which were further diagnosed as Endometrioid carcinoma in two cases and Carcinosarcoma in one case seen as tumor composed of epithelial and sarcomatous component seen as malignant glands and stroma with areas of necrosis and brisk mitosis on histopathology. All these cases were concordant.

Table 45-Discordant cases of Endometrium on Imprint cytology [n=5]

Non- neoplastic cases	Diagnosis on Histopathology	Reason for discordance
Deferred cases (2)	Normal elements(2)	Insufficient cellularity
Neoplastic cases		
Suspicious for malignancy (3)	Benign Endometrial polyp (2)	Cannot be diagnosed on Imprint cytology
	Normal elements (1)	Interpretation error

Two deferred cases on imprint cytology due to insufficient cellularity showed normal elements on histopathology. Three cases diagnosed as Suspicious for malignancy on imprint cytology because of technically poor preparation and the cells appeared enlarged and hyperchromatic mimicking tumor cells, were diagnosed as Benign endometrial polyp on histopathology in two cases as it cannot be diagnosed on imprint cytology and one case was diagnosed as normal elements.

Table 46-Discordant cases of Endometrium on Frozen section [n=4]

Diagnosis on frozen section	Diagnosis on Histopathology	Reason for discordance
Deferred cases (1)	Normal elements (1)	Insufficient cellularity
Normal elements (1)	Benign Endometrial polyp (1)	Interpretation error
Endometrial hyperplasia (2)	Normal elements (1)	Technical error
	Benign endometrial polyp (1)	Interpretation error

Out of 4 discordant cases on frozen section, one case was deferred and non-diagnostic due to insufficient cellularity. One case diagnosed as normal elements on frozen section showed features of Benign endometrial polyp, reason being interpretation error. Two cases diagnosed as Endometrial hyperplasia on frozen section was diagnosed as normal elements and Benign endometrial polyp, respectively, reason for discordance being technical error and interpretation error.

Table 47- Correlation of Imprint cytology and Frozen section with histopathology in Endometrium (n=27)

	Concordant with Histopathology	Percentage	Discordant with Histopathology	Percentage
Imprint cytology	22	81.4%	5	18.51%
Frozen section	23	85.18%	4	14.81%

Out of 27 cases,22 [70.4%] cases on imprint cytology were concordant with histopathology and 5 cases [18.51%] were discordant with histopathology.

Out of 27 cases,23 cases [85.18%] on frozen section were concordant with histopathology and 4 cases [14.81%] were discordant with histopathology.

Sensitivity, specificity, PPV, NPV rate for Endometrium on Imprint cytology

True positive: 6/27

True negative: 18/27

False positive: 3/27

False negative: 0/27

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{6}{6+0} \times 100 = 100\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{18}{18+3} \times 100 = 85.7\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{6}{6+3} \times 100 = 66.67\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{18}{18+0} \times 100 = 100\%$

5)p- value: 0.001,hence significant**.**

Sensitivity, specificity, PPV, NPV rate for Endometrium on Frozen section

True positive: 6/27

True negative: 21/27

False positive: 0/27

False negative: 0/27

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{6}{6+0} \times 100 = 100\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{21}{21+0} \times 100 = 100\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{6}{6+0} \times 100 = 100\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{21}{21+0} \times 100 = 100\%$

5) P-value: 0.001, hence significant.

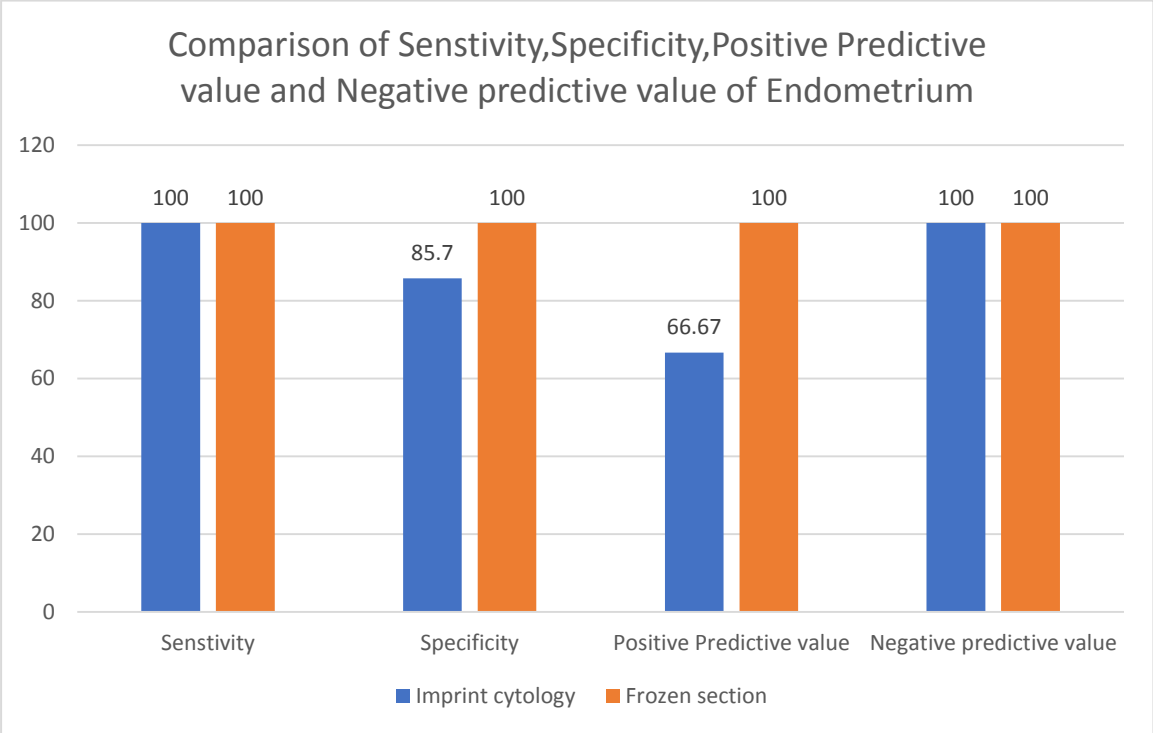

Figure No. 4: Comparison of Sensitivity, Specificity, Positive Predictive value and Negative predictive value of Endometrium

Senstivity and negative predictive value were similar for endometrium in both the modalities whereas specificity and positive predictive value were better for frozen section.

5.GALL BLADDER [n=14]

Gall bladder excisions were sent for intraoperative diagnosis of malignancy.

Table 48- Age group distribution of patients with gall bladder intraoperative consultations (in years) (n=14)

Age group	No. of cases	Percentage
< 30	2	14.3%
31-40	3	21.4%
41-50	5	35.7%
51-60	4	28.6%
> 60	0	0.0%
Mean	54.4 years	
Median	55.0 years	

Five cases [5.7%] were between the age group 41-50 years, 4 cases [28.6%] in age group of 51-60 years, 3 cases [21.4%] in age group of 31-40 years and 2 cases [14.35%] less than 30 years of age.

Table 49- Sex distribution of patients with gall bladder intraoperative consultations (n=14)

Sex	No. of cases	Percentage
Female	8	57.1%
Male	6	42.9%
Total	14	100%

Eight patients [57.1%] were females whereas 6 [42.9%] were males. Male to female ratio was 1:1.3.

Table 50- Type of specimen received for frozen section [n=14]

Type of Specimen	No. of cases	Percentage
Large	10	71.4%
Small	4	28.6%
Total	14	100%

Ten specimen [71.4%] were large and measured more than 5 cm where as 4 specimens [28.6%] were small. All were cholecystectomy specimens.

Table 51- Time taken to diagnose imprint cytology for gall bladder (n=14)

Imprint cytology time (in minutes)	No. of cases	Percentage
< 20	8	57.1%
21-40	5	35.7%
> 40	1	7.1%
Mean	22.5 minutes	
Median	19.5 minutes	

During imprint cytology, 8 cases [57.1%] took less than 20 minutes for diagnosis, 5 cases [35.7%] took 21-40 minutes to diagnose while 1 case [7.1%] took more than 40 minutes to diagnose.

Table 52- Time taken to diagnose frozen section for gall bladder(n=14)

Frozen section time (in minutes)	No. of cases	Percentage
< 20	1	7.1%
21-40	12	85.7%
41-60	1	7.1%
> 60	0	0.0%
Mean	31.4 minutes	
Median	32 minutes	

Most of the cases i.e.12 [85.7%] were diagnosed in 21-40 minutes on frozen section and one case each [7.1%] took less than 20 minutes and more than 40 minutes to diagnose.

Table 53- Diagnosis of gall bladder excisions on Imprint cytology(n=14)

Diagnosis	**No. of cases**	**Percentage**
Non-Neoplastic	8	57.1%
Neoplastic	6	42.8%
Deferred	0	0

8 cases [57.1%] were diagnosed as non neoplastic and 6 cases [42.8%] were neoplastic. Non-neoplastic cases included cases showing normal elements, case of chronic cholecystitis and cases of Xanthogranulomatous cholecystitis.Neoplastic cases included cases of Adenocarcinoma gall bladder.

Table 54- Non neoplastic cases in gall bladder [n=8]-IMPRINT CYTOLOGY

Diagnosis	Imprint cytology		Histopathology	
	No. of cases	Percentage	No. of cases	Percentage
Normal elements	3	37.5%	3	37.5%
Chronic cholecystitis	1	12.5%	1	12.5%
Xanthogranulomatous cholecystitis	4	50%	4	50%
Total	8	100%	8	100%

On imprint cytology three cases [37.5%] were diagnosed as normal gall bladder with no evidence of malignancy, one case [12.5%] as chronic cholecystitis and 4 cases [50%] as xanthogranulomatous cholecystitis due to presence of sheets of foamy macrophages in the background along with monolayered sheets of benign columnar epithelial cells.

Neoplastic cases in gall bladder [n=6]-IMPRINT CYTOLOGY

Six neoplastic cases of gall bladder were labelled as Positive for malignancy and hence, carcinoma and were concordant with the final histopathology.

Table 55- Diagnosis of gall bladder on Frozen section(n=14)

Diagnosis	**No. of cases**	**Percentage**
Non-Neoplastic	10	71.4%
Neoplastic	4	28.5%
Deferred	0	0
Total	14	100%

Ten cases [71.4%] were diagnosed as non neoplastic and 4 cases [28.5%] were neoplastic.Non-neoplastic cases included cases of normal elements,chronic cholecystitis, xanthogranulomatous cholecystitis.

Table 56- Diagnosis of frozen section in gall bladder [n=14]- FROZEN SECTION

Diagnosis	Imprint cytology		Histopathology	
	No. of cases	Percentage	No. of cases	Percentage
Normal elements	3	21.4%	3	21.4%
Chronic cholecystitis	1	7.14%	1	7.14%
Xanthogranulomatous cholecystitis	4	28.5%	4	28.5%
Mesothelial cell proliferation	1	7.14%	0	0
Non-neoplastic,NOS - Reactive	1	7.14	0	0
Adenocarcinoma	4	28.5%	6	42.8%
Total	14	100%	14	100%

On frozen section 3 cases [21.4%] were diagnosed as normal gall bladder with no evidence of malignancy, 1 case [7.14%] as chronic cholecystitis and 4 cases [28.5%] as xanthogranulomatous cholecystitis. One case[7.14%] in which the epithelium was eroded was labelled Non-neoplastic,NOS-Reactive atypia[7.14%] because few of the cells showed nucleomegaly which was diagnosed Adenocarcinoma on histopathology. In one case [7.14%] mesothelial cell proliferation was seen hence was labelled so, it was finally diagnosed as adenocarcinoma on histopathology. Out of the four neoplastic cases[28.5%] of gall bladder, one case was diagnosed as Intramucosal carcinoma and 3 cases as Adenocarcinoma [75%] because the tumor was invading upto the muscularis.

Table 57- Correlation of Imprint cytology and Frozen section with histopathology in gall bladder (n=14)

	Concordant with Histopathology	Percentage	Discordant with Histopathology	Percentage
Imprint cytology	14	100%	0	0%
Frozen section	12	85.7%	2	14.3%

All the cases of gall bladder on imprint cytology were concordant with histopathology.

On frozen section, 12 cases [78.5%] were concordant which included normal gall bladder (3 cases), Chronic cholecystitis (1 case), Xanthogranulomatous cholecystitis (4 cases) and Adenocarcinoma (4 cases).

Table 58- Discordant cases between Frozen section and Histopathology of GALL BLADDER (n=2)

Diagnosis on Frozen section	**Diagnosis on Histopathology**	**Reason for discordance**
Non-neoplastic, NOS(Reactive)	Adenocarcinoma	Interpretation error
Mesothelial cell proliferation	Adenocarcinoma	Sampling error

Two cases of frozen section which were discordant with histopathology, were diagnosed as Adenocarcinoma on histopathology.

One case diagnosed as Adenocarcinoma on histopathology was labelled Reactive on Frozen because the cell morphology was not clear and invasive focus could not be found.

One case was labelled as mesothelial cell proliferation on Frozen was later diagnosed as adenocarcinoma because of sampling error earlier.

Sensitivity, specificity, PPV, NPV rate of Gall bladder on imprint cytology

True positive: 6/14

True negative: 8/14

False positive: 0/14

False negative: 0/14

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{6}{6+0} \times 100 = 100\%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{8}{8+0} \times 100 = 100\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{6}{6+0} \times 100 = 100\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{8}{8+0} \times 100 = 100\%$

5) P-value: 0.001, hence significant.

Sensitivity, specificity, PPV, NPV rate for Gall bladder on frozen section

True positive: 4/14

True negative: 8/14

False positive: 0/14

False negative: 2/14

1)Sensitivity: $\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{4}{4+2} \times 100 = 66.6\ \%$

2)Specificity: $\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{8}{8+0} \times 100 = 100\%$

3)PPV: $\frac{\text{True positive}}{\text{True positive+ false positive}} \times 100 = \frac{4}{4+0} \times 100 = 100\%$

4)NPV: $\frac{\text{True negative}}{\text{True negative+ false negative}} \times 100 = \frac{8}{8+2} \times 100 = 80\%$

5) P-value: 0.009, hence significant.

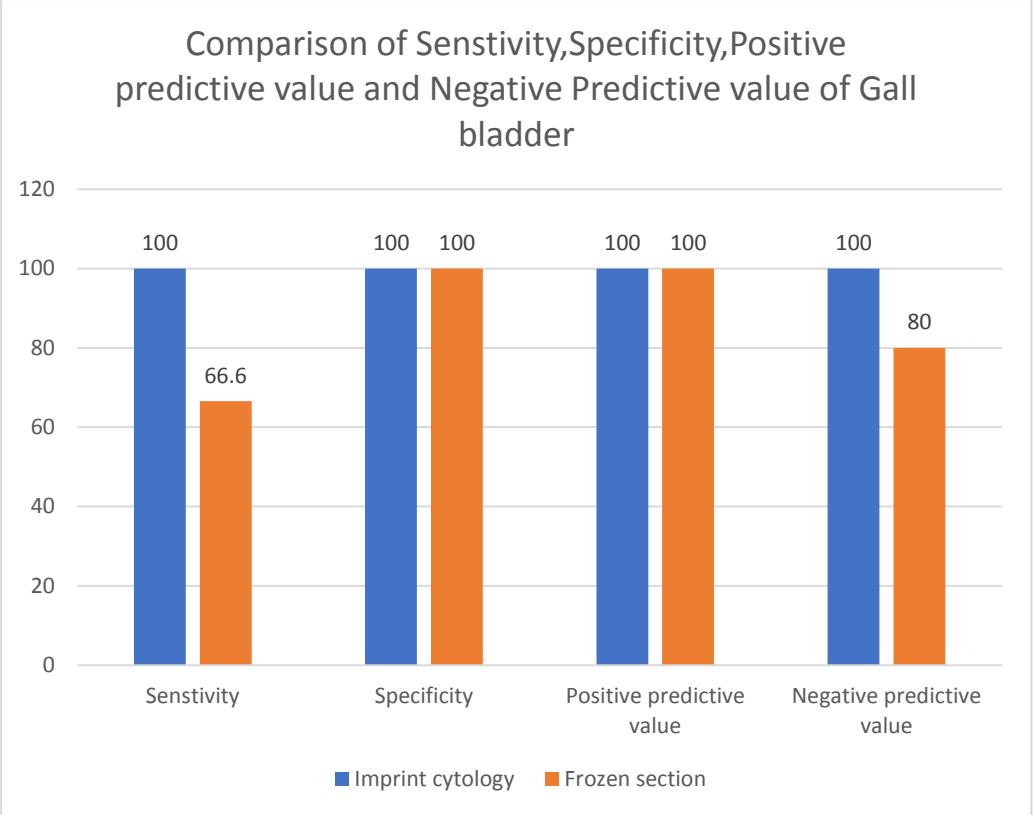

Figure No. 5: Comparison of Sensitivity, Specificity, Positive predictive value and Negative Predictive value of Gall bladder

In case of gall bladder, Imprint cytology was better than frozen section with respect to sensitivity, specificity, positive predictive value and negative predictive value.

6. Parathyroid gland (n=10)

All 10 cases were sent for intra-operative diagnosis of malignancy. Mean age was 56.1 years. Six were females and 4 were males with male to female ratio of 1:1.5. Cinical diagnosis was available in all the cases and was parathyroid adenoma. Imprints smears showed scattered naked nuclei and loose clusters. Other architectural features included a papillary pattern with a fibrovascular core, tight clusters, and a follicular pattern. Almost all nuclei were centrally located, round to oval and similar in size to red blood cells with a regular nuclear membrane. A small proportion of parathyroid cells showed mild to moderate anisokaryosis on imprints in each case. The chromatin was coarse and stippled. Some cells had eccentric nuclei, a well-defined

cell border, and oxyphilic cytoplasm. Prominent nucleoli and intranuclear pseudoinclusions were only detected in one. On frozen section, the cases showed a well encapsulated tumour with tumour cells arranged in nests. Individual tumour cells had hyperchromatic nuclei with abundant clear cytoplasm and adjacent compressed normal parathyroid tissue hence were reported as parathyroid adenoma. All 9 cases were concordant with final histopathological diagnosis as it showed the same morphology.

6. Knee joint tissue (n=4)

Knee joint tissue was received to detect infection post total knee replacement surgery and to see number of neutrophils/hpf. Two were male and two were females with male to female ratio of 1:1. Mean age was 62.5 years. No neutrophils were found in 3 cases on imprint cytology as well as frozen section while in 1 case prominence of neutrophils was seen suggestive of infected total knee replacement. The results were concordant with final histopathological diagnosis.

7. Bowel nodule (n=3)

Three cases of bowel nodule were received to look for evidence of metastasis. One was female and two were males with male to female ratio of 2:1.Mean age was 53.3 years.

Of these 1 patient was a known case of Granulosa cell tumor ovary and bowel nodule was sent. It was found negative for metastasis on both frozen and imprints.

Two cases in which the growth was in periampullary region and distal colon showed presence of metastatic carcinomatous deposits on both frozen and imprints. All 3 cases were concordant with the final histopathological diagnosis.

8. Buccal mucosa (n=6)

Six buccal mucosal biopsies were received for intraoperative diagnosis of malignancy. Four were males and two were females with male to female ratio of 2:1. Mean age was 55.5 years.

Of these, five cases showed features of squamous cell carcinoma on imprint cytology seen as clusters of cells with overlapping nuclei and prominent nucleoli that may be due to the deeper invasion of tumor cells or loss of cell cohesiveness. The nuclei showed irregular outlines and marked pleomorphism. Under high power, alterations in nucleus-cytoplasm ratio, hyperchromasia and atypia were evident. The mitotic figures on touch imprint smears were few or absent, because they tended to rupture during imprinting. On frozen section, individual tumour cells had vesicular nuclei, prominent nucleoli and moderate amount of cytoplasm. Individual cell keratinisation along with keratin pearls seen. Hence, were reported as squamous cell carcinoma, concordant with histopathology.

One case was negative for malignancy and showed scattered mature squamous epithelial cells on imprint cytology with no atypia. On frozen section orderly cell maturation of epithelium was seen, thus was concordant with histopathology.

9. Cervix(n=3)

All 3 cases were sent with high clinical suspicion of carcinoma cervix. Mean age was 44.3 years.

On imprint cytology and frozen section, 2 cases showed normal mature squamous epithelial tissue only while one case showed features of squamous cell carcinoma.

The case reported as squamous cell carcinoma on imprint cytology showed scattered tumor cells exhibiting nuclear hyperchromasia and nucleomegaly while on frozen section it showed tumour cells arranged in nests and sheets. Individual cells were polygonal in shape with vesicular nuclei, prominent nucleoli and moderate amount of

cytoplasm. Individual cell keratinization, keratin pearls and intercellular bridges were also formed and on final histopathology as well this case was reported as squamous cell carcinoma.

10. Fibroid (n=3)

Three cases were received for primary diagnosis. Mean age was 35.6 years. On cut section, all showed whorling. All 3 cases on imprint cytology showed clusters of cells with spindle shaped nuclei and hyperchromasia. No necrosis, mitosis seen. Hence diagnosis of spindle cell neoplasm was rendered.

On frozen section, tumor was well circumscribed and showed Intersecting fascicles of monotonous spindle cells with indistinct borders, eosinophilic cytoplasm, cigar shaped nuclei (with tapered ends) and small nucleoli. Atypia was absent. No mitosis was seen. Diagnosis was Leiomyoma.

On histopathology, similarly diagnosis of leiomyoma with hyaline change was given.

11. Liver (n=3)

All 3 cases were sent to enquire the presence of any metastatic deposit. Two were males and one was female with male to female ratio of 2:1.Mean age was 54.6 years. On imprint cytology, scattered hepatocytes were seen which in one case showed pigment and histiocytes. On frozen section, normal hepatic architecture was seen with no evidence of deposits. On histopathology, maintained lobular architecture of hepatocytes was seen with no evidence of malignancy. All 3 cases were concordant with histopathological diagnosis.

12. Omentum (n=3)

All 3 cases were sent to enquire about any metastasis. Two were females and one was male with male to female ratio of 1:2. Mean age was 64 years.

One case showed clusters of large atypical cells with hyperchromatic nuclei and vacuolated cytoplasm and was diagnosed positive for malignancy. On frozen section, similar cells with hyperchromatic nuclei and vacuolated cytoplasm were seen, henace diagnosis of Metastatic carcinomatous deposits was given.

On final histopathology, nests and singly scattered large cells were seen having vesicular nuclei and vacuolated cytoplasm. Diagnosis of Metastatic carcinomatous deposits was given.

Two cases showed only fibrofatty stromal fragments with no atypical cells on imprint cytology and frozen section and hence was diagnosed as negative for malignancy.

Similarly both these cases on histopathology showed only fibrofatty tissue with no infiltration by atypical cells. Hence, Negative for malignancy.

13. Parotid gland (n=3)

3 cases were received for primary diagnosis. Two were females and one was male with male to female ratio of 1:2.Mean age was 55.6 years.

One case on cut section was cystic and drained out pultaceous material. On imprint cytology scant degenerated cuboidal, oncocytic or squamoid epithelial cells were seen with inflammatory cells and diagnosis of benign cyst was given. Frozen section and histopathology showed a cyst lined by cuboidal and partially by pseudostratified columnar epithelium and at places by squamous epithelium with interspersed mucus cells. The cyst wall was fibrocollagenous and showed focal lymphoid aggregates, lymphocytes, histiocytes, plasma cells. Diagnosis of Retention cyst was given.

One case on imprint cytology showed presence of mucin with scattered epidermoid cells having large nuclei, prominent nuclei creating a suspicion of malignancy. On frozen section, mucin was seen with squamoid cells having enlarged nuclei, hence diagnosis was given as

Neoplasm. On histopathology, a circumscribed tumor with cystic growth of epidermoid, intermediate, mucinous cells and clear cells was seen. The glandular spaces contained mucin, hence finally it was diagnosed as Mucoepidermoid carcinoma.

One case showed acinar-like cells tending to form small groups and loosely cohesive clusters as well as single cells with round nuclei with tiny nucleoli, abundant finely vacuolated to granular cytoplasm on imprint cytology, hence diagnosed as suspicious for malignancy. On frozen section it showed follicular pattern of arrangement of tumor cells which were large and polyhedral, with basophilic granular cytoplasm and eccentric nuclei and prominent lymphoid infiltrate was seen. Diagnosis of tumor was given. On histopathology, a tumor with cystic and solid pattern was seen with large polyhedral cells having basophilic granular cytoplasm and eccentric nuclei. Prominent lymphocytic infiltrate was also seen. Hence diagnosed as Acinic cell carcinoma finally.

14. Brain (n=2)

2 cases of brain were received for primary diagnosis. Both were females with mean age of 37.5 years.

1 case on imprint cytology showed presence of epitheloid cells arranged in clusters and as singly dissociated cells having round to oval nuclei and streaked cytoplasm, had high N/C ratio. Hence diagnosis of positive for malignancy was made. This case on frozen section showed a cellular tumor having whorls of tumor cells with oval nuclei with moderate amount of cytoplasm. No mitosis or necrosis was seen. Diagnosis of meningioma was made which was concordant with final histopathological diagnosis.

One case on imprint cytology showed cellular smear, with moderate to markedly pleomorphic cells with fine fibrillar glial processes. Palisading around areas of geographic necrosis was seen, hence diagnosed as tumor. This case on frozen section showed presence of hypercellular

infiltrative lesion with variable morphology, nuclear hyperchromasia and nuclear elongation, necrosis with palisading of cells around areas of geographic necrosis suggesting of a High grade tumor which on histopathology showed morphology of Glioblastoma.

15. Cervical lymph node (n=2)

One case were sent to look for primary diagnosis and other was sent to look for evidence of infection.

In one case was female aged 59 years of lymph node on imprint cytology, there were seen few clusters of round monomorphic cells, having hyperchromatic nuclei and inconspicuous nucleoli and scant cytoplasm and diagnosis of suspicious for malignancy was given. On frozen section showed presence of similar monomorphic cells in sheets and hence diagnosis of Round cell tumor was made which was further concordant with the histopathological diagnosis of metastatic carcinomatous deposits from a small cell carcinoma.

Second case was of male aged 44 years to look for infective pathology and on imprint cytology showed presence of histiocytic collections against a background of reactive lymphoid cells. Hence, diagnosis of inflammatory pathology, possibly chronic was made. This on frozen section and histopathology showed ill formed epithelioid cell granuloma against a necrotic background and hence diagnosed as Granulomatous lymphadenitis.

16. Tongue (n=3)

Three cases were sent from ulcers of tongue to rule out malignancy. Two were female with male to female ratio of 1:2. Mean age was 59 years.

Two specimens on imprint cytology showed presence of clusters and singly scattered cells with high N/C ratio, hyperchromatic nuclei, coarse chromatin, irregular nuclear contours and scant cytoplasm. Tadpole cells and fiber cells were also seen with keratin pearls. Hence diagnosis of squamous cell carcinoma was made. On frozen section,

dysplastic epithelium was seen having eosinophilic cytoplasm, hyperchromatic nuclei and nuclear pleomorphism. Individual cell keratinisation was also noted. Hence diagnosed as Squamous cell carcinoma which was concordant with histopathology.

One case was reported negative for malignancy on imprint cytology and showed scattered mature squamous epithelial cells with no features of malignancy. Similarly on frozen section, orderly cell maturation of squamous epithelium with no features of malignancy were seen. Similar features were observed in final histopathology. Hence, diagnosis as negative for malignancy which was concordant with the histopathological diagnosis.

17. Eyelid lesion (n=2)

One case was female aged 49 years on imprint cytology showed presence of few mature squamous epithelial cells with few pigmented cells. No evidence of malignancy was seen in the smears examined. Same case on frozen section showed presence of normal squamous epithelium with no dysplastic features. Pigmented cells were also seen with presence of mild chronic inflammatory infiltrate. However, no evidence of malignancy was seen. This case was reported as Candidiasis on histopathology because of spores of candida.

One case was male aged 71 years on imprint cytology showed presence of clusters of cells with high N/C ratio with monotonous epithelial cells, with ovoid nuclei and moderate amount of cytoplasm. Extracellular mucin was also noted. Hence, diagnosis of positive for malignancy was given. This on frozen section showed presence of a tumor arranged in sheets with columnar cells having apical snouts with extracellular and intracellular mucin. Diagnosis of Epithelial neoplasm was given on frozen section which on histopathology showed a cellular tumor arranged in nests, solid and cribriform architecture having bland columnar secretory cells, intracellular mucin and stippled chromatin against a myxoid background. Hence 2 possibilities were suggested

1.Mucinous eccrine carcinoma 2.Endocrine mucin secreting sweat gland carcinoma.

18. Urinary bladder (n=2)

Two cases from urinary bladder were sent to know the primary diagnosis of the same patient was a female aged 50 years.

In both the cases, on case of imprint cytology, there were present clusters and papillae of tumor cells having hyperchromatic nuclei and scant amount of cytoplasm.

On frozen section, tumor arranged in papillary architecture was seen, with papillae lined by cells which were more than 3 layers thick exhibiting nuclear hyperchromasia with scant cytoplasm, Hence, diagnosis of urothelial carcinoma was made. On histopathology, diagnosis of Invasive papillary urothelial carcinoma was made and in one case muscle bundle included in biopsy was invaded by tumor.

19. Breast lump (n=1)

Breast tissue was received to know the primary diagnosis was a 40 year female.

On imprint cytology the smears were cellular and showed presence of tumor cells arranged in clusters with high N/c ratio, irregular nuclear contours, coarse chromatin, prominent nucleoli and scant amount of cytoplasm, diagnosis of positive for malignancy was given. On frozen section and histopathology both, a tumor with cells arranged in tubules and ducts was seen having pleomorphic hyperchromatic nuclei and scant amount of cytoplasm. Diagnosis of Invasive duct carcinoma, NOS was given on both.

20. Lung tissue(n=1)

One case was sent to know the infective cause was male aged 51 years.

On imprint cytology, clusters of alveolar epithelial cells were seen against a background containing inflammatory cells seen as plasma

cells, neutrophils and lymphocytes. No atypical cells were seen. On frozen section, alveolar epithelial cells were seen with infiltration by inflammatory infiltrate seen as neutrophils, lymphocytes and plasma cells. Anthracotic pigment was seen. Similar findings were seen on histopathology along with osteoid metaplasia and fibroblastic proliferation, Hence no atypical cells were seen and diagnosis of Inflammatory pathology was given.

21. Mandible(n=1)

Mandibular tissue was sent to know the primary diagnosis was a male aged 56 years.

On imprint cytology, presence of tumor cells which were polygonal having high N/c ratio, coarse chromatin, nuclear pleomorphism and scant amount of cytoplasm with a background containing scattered mature squamous epithelial cells was noted. Hence, diagnosis of positive for malignancy was given.

On frozen section was seen a tumor with tumor cells arranged in nests having marked cytological atypia and vesicular nuclei. Mitosis were seen. Diagnosis of Malignant Epithelial tumor was made on frozen section. This tumor on histopathology showed cells present in nests and lobules exhibiting peripheral palisading, reverse polarisation. Areas of necrosis and mitosis also identified and a diagnosis of Ameloblastic carcinoma was made on histopathology, thus concordant.

22. Nose(n=1)

1 case from nose with a history of nasal growth and obstruction was female aged 64 years was received in which imprint smears showed presence of clusters of tumor cells with basaloid cells with palisading at the periphery. The cells had high N/C ratio, minimal cellular atypia, prominent nucleoli and scant amount of cytoplasm. Hence, possibility of basal cell carcinoma was kept. On frozen section, was seen a circumscribed mass large lobules of basaloid cells with peripheral nuclear palisading and a fibromyxoid stroma. Retraction clefts were

also seen. Strong suspicion of Basal cell carcinoma was kept which on histopathology showed concordance.

23. Thigh(n=1)

Thigh specimen was of 20 year female was sent with a clinical suspicion of AV malformation. On imprint cytology, large uniform epitheloid cells having abundant eosinophilic granular cytoplasm were seen scattered singly. Hence, a diagnosis of tumor with epitheloid morphology was made. On frozen section, we saw a tumor with cells arranged in solid nests and/or alveolar structures and has PASD+ intracytoplasmic rhomboid or rod shaped crystals. Intraoperatively frozen section was suggestive of tumor with epithelioid morphology. On histopathology, presence of tumour cells arranged in nests and alveolar growth pattern was seen. The tumor cells were large rounded to polygonal with vesicular nuclei, prominent nucleoli and abundant amount of eosinophilic granular cytoplasm**.** Periodic acid Schiff-Diastase stained section highlighted intracytoplasmic rod shaped crystals. Hence diagnosis of Alveolar soft part sarcoma was made on histopathology, thus concordant.

24. Scar site ectopic(n=1)

It is a very rare indication of performing a frozen section.It was from a female aged 38 years.

In case of imprint cytology, only mucus and few endometrial and endocervical cells were obtained. Frozen section showed no chorionic villi or trophoblastic tissue. Only normal endometrial cells were seen. On histopathology again, no chorionic villi, trophoblastic tissue was noted. Hence diagnosis of no specific pathology was given in all, thus concordant.

25. Anterior abdominal cyst wall(n=1)

One specimen from Anterior abdominal cyst wall was a female ages 45 years was sent to know the whether there was any evidence of malignancy or not. The tissue on imprint cytology was very scant and

showed few fibrofatty fragments only. On frozen section again fibrofatty stromal fragments were seen. On final histopathological diagnosis, no evidence of malignancy was seen and hence was concordant with imprint cytology and frozen section.

DEFFERED CASES-Both on Imprint Cytology and Frozen section

2 cases which were sent to know the evidence of metastasis were deferred.

First case was sent from duodenum in which there was a suspicion of cholangiocarcinoma, and duodenum was thickened. In this case on imprint cytology, only scattered inflammatory cells with multinucleate giant cells and foamy macrophages were seen. However on frozen section, many hyperchromatic enlarged cells were seen, due to thick section, giving doubtful interpretation. Hence case was deferred.

Second case was sent from biliary fistula. The tissue was so small that barely any material was present in imprint cytology and hence non-diagnostic. In case of frozen section similarly due to insufficient cellularity diagnosis was deferred.

Analysis of sensitivity, specificity, false positive, false negative rates of Imprint cytology overall

279 specimens were evaluated on imprint cytology. Imprint cytology was reported in 89 cases as true positive (positive on paraffin section) and 9 were false positive (negative on paraffin section). Frozen section was reported in 173 cases as true negative (negative on paraffin section) and 8 were false negative (positive on paraffin section).

A) Sensitivity of imprint cytology

$$\frac{\text{True positive}}{\text{True positive + False negative}} \times 100 = \frac{89}{89+8} \times 100 = \mathbf{91.7\%}$$

B) Specificity of imprint cytology

$$\frac{\text{True negative}}{\text{True negative + False positive}} \times 100 = \frac{173}{173+9} \times 100 = \mathbf{95.05\%}$$

C) Positive predictive value of imprint cytology

True positive x 100 = 89/89+9x100= **90.8%**

True positive+ false positive

D) Negative predictive value of imprint cytology

True negative x 100 = 173/173+8x100=**95.5%**

True negative+ false negative

E)p-value-0.001 ,hence significant.

Analysis of sensitivity, specificity, false positive, false negative rates of Frozen section overall

279 specimens were evaluated on frozen section. Frozen section was reported in 90 cases as true positive (positive on paraffin section) and 3 were false positive (negative on paraffin section). Frozen section was reported in 180 cases as true negative

(negative on paraffin section) and 6 were false negative (positive on paraffin section).

A) Sensitivity of frozen section

True positive x 100 = 90/90+6 x100=**94.7%**

True positive + False negative

B) Specificity of frozen section

True negative x 100 = 180/180+3 x100 =**98.4%**

True negative + False positive

C) Positive predictive value of frozen section

True positive x 100 = 90/90+3x100= **96.7%**

True positive+ false positive

D) Negative predictive value of frozen section

True negative x 100 = 180/180+6x100=**96.7%**

True negative+ false negative

E)p-value-0.001,hence significant.

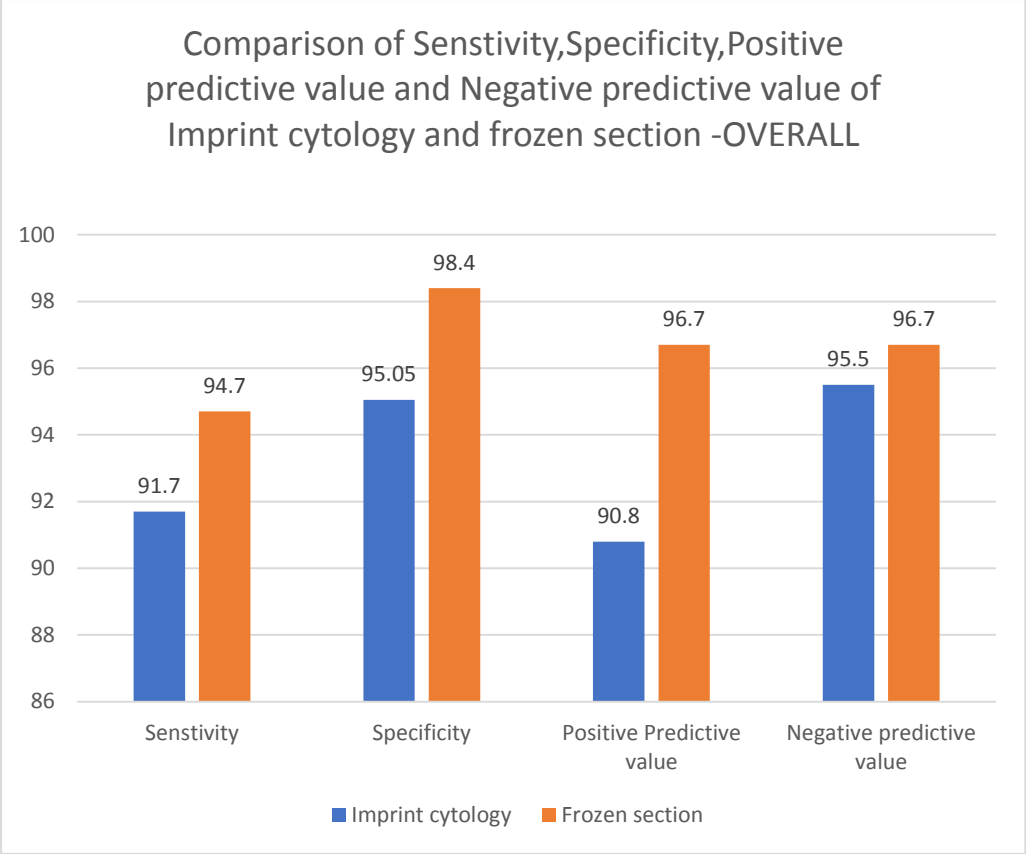

Figure No. 6: Comparison of Sensitivity, Specificity, Positive predictive value and Negative predictive value of Imprint cytology and frozen section -OVERALL

The overall sensitivity, specificity, positive predictive value and negative predictive value were better for frozen section section as compared to imprint cytology.

DISCUSSION

Pathological assessment of tissue specimens during biopsy or surgery is usually assessed by the pathologist in formalin fixed paraffin embedded section. However, occasionally surgeons need pathologic information more urgently thus, they request for an intra-operative consultation on the tissue that is being taken out (known as frozen section). The examination is made intraoperatively during the process of surgery. Although frozen section is commonly used, Imprint cytology of tissue sent for intraoperative consultation can be even quicker with a good sensitivity and high diagnostic value.

We had conducted this study at the Department of Pathology at Dayanand Medical College and Hospital, Ludhiana over a period of 1 year prospectively from 15th September 2022- 14th September 2023 to assess the efficacy and utility of Imprint cytology and frozen section technique to analyse its effectiveness in providing the intraoperative diagnosis.

In our study period we received a request for 281 frozen sections. The time of receiving the specimen in the department and the time at which the frozen section report was informed to the surgeon was noted for every case as it was a critical parameter. Sections from the representative areas were processed along with making 3 imprints on glass slides. Imprint slides were stained with Toludine blue stain, Giemsa stain and Rapid Haemotoxylin and eosin stain. After reporting the frozen section, the remaining tissue was fixed in formalin and processed for general histo-pathological examination. A comparison was done between the imprint smears, frozen section and final histopathological findings.

Age and Gender

The commonest age group who underwent intraoperative consultation was 41 to 50 years comprising of 79 cases [28.1%], alike the study done by Ahuja S et al [96] in 2024 who also showed similar findings with most common age group to be 41-50 years. Another study done by Kediya A

et al [95] in 2023 also observed the mean age to be 53.14 years which was almost same as our study (53.2 years).

In the present study overall intraoperative consultation was done more in females constituting 226 cases [80.4%] with a male to female ratio of 1:4.1 which is in concordance with the study done by Shaha S A et al [97] in the year 2009 who reported male to female ratio of 1:5.3. This is probably due to the fact that intraoperative consultations for sentinel lymph nodes in breast carcinoma is gold standard for surgical staging of axilla. Moreover, gynaecological surgeries of the ovaries and endometrium comprise a major chunk of histopathological workload in our hospital set-up.

Indications of Frozen section

The various indications of intraoperative consultation was to establish the nature of a lesion, whether neoplastic or nonneoplastic and if neoplastic, whether it is benign or malignant so that the further surgical procedure can be planned accordingly while the patient was on the operating table. Adequacy of the resected margins in a diagnosed case of malignant tumor was another important indication. Another indication was to establish the evidence of metastasis in the sentinel lymph nodes and to look for metastatic deposits in omentum and bowel nodule. We also tried to determine the etiology of nonneoplastic lesions namely infectious cause i.e. granulomatous cause or endometriosis in the ovary.

In our study in 127 cases [45.19%] frozen section was requested to determine the primary diagnosis of various organs, 108 cases [38.43%] were done to look for metastasis in the sentinel lymph node, omentum or peritoneum and 40 cases [14.23%] were sent to assess the status of resected margins in diagnosed cases of malignant tumor. Studies done by Jaiswal YP et al, Khalid A et al mentioned similar indications for their studies.

Table – 59 Indications of different studies for Imprint cytology and frozen section

Author	Number of cases	Primary diagnosis	Resected margin status	Metastasis
Jaiswal Y P et al [5] (2020)	52	9.3%	65%	25.6%
Khalid A et al[34] (2004)	60	83.3%	3.33%	13.33%
Pallialil et al [98] (2023)	157	92.3%	34.39%	4.45%
Present study (2024)	281	45.19%	14.23%	38.4%

Type of specimen received for evaluation

Out of the total 281 specimens, 58 [20.6%] were large specimens and 223 specimens [79.4%] were small. Small specimens included any specimen of size less then 5 cm which included endometrial curettings, resected margins, sentinel lymph nodes and suspected nodules of metastatic deposit. The large specimens included resection specimens like hysterectomies, cholecystectomies, appendicectomies, ovarian masses, parathyroidectomies, segment of intestine and large volume endometrial curretings. The large specimens affected the revert time which was prolonged as in some cases selection of the sampled area was difficult and in an occasional case we had to put in multiple pieces to reach to a diagnosis.

Time taken for evaluation of imprint cytology and frozen section

It was calculated from the time the specimen was received in our department to the time the report of frozen section was informed to the operating surgeon. The time for diagnosing imprint cytology slides was also noted. Diagnosis of approximately half of the cases ,140 [49.82%] on imprint cytology was reported in less than 20 minutes and in rest of 126 cases [44.84%] the revert time was 21-40 minutes. However, on

frozen section reporting approximately 3/4th [197 (70.1%)] of the same cases took minimum 21-40 minutes while in 66 cases [23.5%] the revert time was even between 41-60 minutes. Using imprint cytology only 15 cases [5.33%], took this much time i.e. more than 40 minutes. On frozen only 10 cases [3.6%] could be reported in less than 20 minutes and 8 cases [2.8%] took even longer than 60 minutes. Mean time taken on imprint cytology for diagnosis was 22.63 minutes while on frozen section it was 35.45 minutes. Thus we can estimate that Imprint cytology diagnosis were quicker and frozen diagnosis took approximately 1.5 times more time for the same.

Observations by Neduvanchery et al,[10] in 2020 also highlight the advantage of early diagnosis on imprints as in their study the mean time duration for reporting for frozen section was 41.18+3.62 minutes whereas for imprint cytology it was 18.12+2.01 minutes. In the study done by Abe M et al,[94] touch imprint cytology took mean of 12 minutes whereas frozen section took mean of 80 minutes to diagnose. The less mean time for frozen section reporting in our institute as compared to other authors signifies the promptness in grossing, cutting, staining and reporting frozen sections.

ORGAN -WISE DISTRIBUTION

SENTINEL LYMPH NODES

Out of 98 cases, ninety seven lymph nodes were received in which the primary was of breast carcinoma and one case was received where primary was thyroid carcinoma. In our study, a total number of 98 sentinel lymph nodes were received for diagnosis with maximum cases [39.8%] being between the age group of 41-50 years which was similar to a study done by Ahuja S et al [96] where maximum cases [56.7%] belonged to the age group of 41-50 years. The mean age was 55.4 years in our study which was again similar to the study done by Ahuja S et al [96] who reported age group as 45.2 years. In another study done by Petropoulou A et al [9] the mean age was 61.3 years which was higher than our study.

Out of 98 cases, 92 cases [93.8%] diagnosed on imprint cytology were concordant with histopathology and 6 cases [6.1%] were discordant. Talking about discordant cases, two cases which were diagnosed Suspicious for malignancy and Metastatic carcinomatous deposit, turned out to be false positive and were diagnosed as Reactive hyperplasia on final histopathology. The reason for discordance was that the cells appeared more crushed and enlarged as well as hyperchromatic on imprint cytology when slides were made improperly as to lead to crush artefact. Four cases diagnosed as benign turned out to false negative as they were diagnosed as Metastatic carcinomatous deposits on final histopathology. The reason for discordance could be sampling error. Our results were similar to study by authors like Ahuja S et al [96] in which out of 40 cases, 30 cases (75%) were given positive for malignancy on imprint cytology and on final histopathology, 34 were positive for malignancy, hence 4 cases were reported negative on imprint cytology which was positive on final histopathology.

On frozen section, 97 cases [98.9%] were concordant with final histopathology and only one case was discordant in which the diagnosis on frozen section was given as suspicious for malignancy was negative for malignancy on final histopathology, the reason being technical error as the cells appeared larger and enlarged on frozen section. The sensitivity, specificity, positive predictive value and negative predictive value for frozen section in our study were 100%, 98.6%, 95.6% and 100% respectively. The similar indicators on Imprint cytology were little less and the same on imprint cytology were 81.8%, 97.3%, 90% and 94.8% respectively.

Table – 60 Analysis of different studies for Imprint cytology and frozen section

Author name	No. Lymph nodes	Technique	Senstivity	Specificity	PPV	NPV
Chang et al(2022)[99]	4327	Imprint cytology	82.70%	99.30%	-	-
Licham et al (2022)[100]	1712	Imprint cytology	91.60%	97.70%	94.10%	96.70%
Abe et al[94] (2020)	55	Imprint cytology	50%	100%	100%	60%
	55	Frozen section	83%	100%	100%	95%
Hashmi et al (2021) [101]	114	Imprint cytology	83.70%	98.5%	-	-
	114	Frozen section	93.30%	100%	-	-
Petropoulou et al (2017) [9]	60	Imprint cytology	90%	100%	100%	98%
	60	Frozen section	80%	100%	100%	96.15%
Neduvanchery et al(2020) [10]	34	Imprint cytology	85.7%	95.8%	80%	97.1%
	34	Frozen section	100%	98.6%	93.3%	100%
Present study	98	Imprint cytology	81.8%	97.3%	90%	94.8%
	98	Frozen section	100%	98.6%	95.6%	100%

Thus after analysing our findings with various other studies we can conclude that overall it has a good concordance rate with frozen section.

The advantage of doing Imprint cytology for lymph node metastasis is that it does not waste any tissue and one does not have to deal with fatty lymph nodes and the impedence that fat causes during tissue cutting along with freezing artifacts. But in case of micrometastasis, it is not possible to detect on Imprint cytology. Since frozen section is more reliable than imprint cytology its use is recommended. But since Imprint cytology is easy to use, inexpensive and rapid and can be used in setups with no cryostat machine. It thus proves it as a subordinate if not as a good alternative to frozen section. We recommend that those centres with other factors like equipment or electricity failures, this can be a modality of intraoperative consultation for ruling out metastasis to sentinel lymph nodes.

OVARY

Among gynaecological specimens, most common organ received for analysis was ovary,44[59.5%] cases, followed by endometrium, 27 [36.4%] cases and then cervix [4.1%] comprising of 3 cases, which was concordant with a study conducted by Kediya et al [95] who had maximum cases of ovaries [68%], followed by uterus [26%] and cervix [6%] for intraoperative consultation.

The mean age for patients whose ovarian resections were sent was 44.3 years which is similar to the studies conducted by Kediya A et al[95] in which the mean age was 53.14 years and Ivan RA et al [102] in which the mean age was 51.18 years. The indication for ovarian specimens was to determine the primary diagnosis and to rule out the possibility of malignancy.

In the case of imprint cytology, 21 cases [47.7%] were diagnosed within 20 minutes, 22 cases [50%] were diagnosed between 21-40 minutes and only 1 case [2.3%] took more than 40 minutes to diagnose because it was a large specimen and there was a lot of inflammatory

infiltrate in the background which came from hemorrhagic fluid on cut section. In case of frozen section, 29 cases [65.9%] took 21-40 minutes to diagnose,13 cases [29.5%] took 41-60 minutes to diagnose and 2 cases [4.5%] took less than 20 minutes to diagnose.

On imprint cytology, 22 cases [50%] each were categorised as Non-neoplastic and Neoplastic. In a study conducted by Ivan et al, out of 76 cases of ovary, only 14 cases [18.37%] were Non- neoplastic and included corpus luteal cyst and endometriotic cyst whereas the others were neoplastic in nature. This study had mainly neoplastic cases and lesser number of non- neoplastic cases than our study. This could be because of surgeons discretion in sending radiologically proven or suspicious for malignancy specimens.

Among the Non-neoplastic diagnosis in our study, sub-categorisation was done into normal elements, endometriosis and non- neoplastic NOS. Out of 22 Non- neoplastic diagnosis, 15 were concordant with final histopathology which included 6 cases of normal elements, 5 cases of endometriosis, 2 cases of hemorrhagic cyst,1 case of simple cyst and 1 case of Benign cystic lesion each. Among the 7 discordant cases, 5 cases which were diagnosed as normal elements on imprint cytology were diagnosed as endometriosis in 3 cases and serous cystadenoma in 2 cases; two cases diagnosed as non-neoplastic, NOS on imprint cytology were diagnosed as Mature cystic teratoma and Serous cystadenofibroma, respectively on histopathology. The reason for discordance could be sampling error. In most studies on imprint cytology of ovarian resections, neoplastic diagnosis were rendered more such as in study done by Dubey A et al,[103] Akbar A et al [104] and Ivan et al.[102]

Of the 22 neoplastic diagnosis on imprint cytology, all the cases were diagnosed neoplastic on histopathology also. These included 2 cases of Benign surface epithelial tumor on imprint cytology diagnosed as serous cystadenofibroma on histopathology; 1 case diagnosed as mature cystic teratoma on both imprint cytology and histopathology; 6

carcinoma cases of imprint cytology were diagnosed on histopathology as Endometrioid carcinoma (4 cases), High grade carcinoma (1 case) and Low grade serous carcinoma (1 case); 8 Mucinous neoplasm on imprint cytology were diagnosed as Mucinous cystadenoma (5 cases), Mucinous borderline tumor (1 case) and Mucinous adenocarcinoma (2 cases) on histopathology; 4 cases of Spindle cell neoplasm on imprint cytology were diagnosed as Thecoma, Fibroma, Adult granulosa cell tumor and Sex cord stromal tumor on histopathology .One case of papillary neoplasm on imprint cytology diagnosed as Adenocarcinoma on Frozen, possibly serous. Borderline cases could not be diagnosed on imprint cytology because of obvious reasons. In the studies by Ivan et al [102] and Shivamurthy et al,[105] borderline lesions were also not diagnosed on imprints. The sensitivity, specificity, PPV and NPV of imprint cytology for ovarian specimen in our study were 84.6%,100%,100% and 81.81%.

Table 61-Comparison of various studies with our study for Imprint cytology of ovarian specimens

Author	No. of cases	Sensitivity	Specificity	PPV	NPV
Stewart et al [106]	402	93%	100%	-	-
Shahid et al[61]	50	95.8%	96%	-	-
Tushar et al [107]	67	93%	92%	-	-
Kediya et al [95]	50	77.5%	90%	96.9%	50%
Present study	44	84.61%	100%	100%	81.81%

Thus our study had highest specificity, positive and negative predictive values among all studies, but sensitivity in our study was found to be relatively low as compared with Stewart et al[106] ,Shahid et al[61] and Tushar et al[107].

On frozen section, out of 22 Non-neoplastic diagnosis, 18 (81.8%) were concordant with histopathology whereas 4 cases were discordant. Concordant cases included 6 cases of normal elements, 7 cases of endometriosis, 2 cases of Hemorrhagic cyst, 1 case of mature cystic teratoma,1 case of simple cyst and 1 case of benign cystic lesion. In a study conducted by Hashmi A et al[101] ,out of 107 benign cases, 45 were non-neoplastic cystic lesions of the ovary including endometriotic, follicular, and corpus luteal cysts on histopathology. Discordant cases in Non-neoplastic lesions included one case given as normal elements on frozen section which was diagnosed as endometriosis on histopathology, one case of endometriosis on frozen section diagnosed as Serous cystadenoma on histopathology, one case of Non-neoplastic, NOS diagnosed as serous cystadenoma on histopathology and one case of Non-neoplastic, NOS diagnosed as Serous cystadenofibroma on histopathology. The discordance is due to sampling error while giving tissue for frozen section and ,mostly, final diagnosis requires examination of multiple sections which is not possible in frozen section. In a study done by Sukrumaran et al[108], out of 122 cases reported as benign on frozen section analysis, diagnostic discrepancy occurred in four cases. In three cases there were focal borderline areas in addition to the predominant benign component. One case showed a combination of benign, borderline and focal low grade invasive carcinoma.

Out of 22 neoplastic cases diagnosed on frozen section in our study, 18 cases were concordant whereas 4 cases were discordant with final histopathology. These were divided into Benign, malignant and neoplasm. Eighteen concordant cases included 3 cases diagnosed as benign,out of which 2 were diagnosed as benign surface epithelial tumor on frozen section diagnosed as serous cystadenofibroma on histopathology and 1 case of dermoid cyst on frozen section as mature cystic teratoma on histopathology. Four cases of Carcinoma on frozen section were further diagnosed as Endometrioid carcinoma in 3 cases on histopathology and one case as High grade carcinoma on

histopathology. One case of Mucinous carcinoma on frozen section was diagnosed as Mucinous Adenocarcinoma on histopathology and 6 cases of Mucinous neoplasm on frozen section as Mucinous cystadenoma in 5 cases and Mucinous borderline tumor in one case on histopathology. Four cases of Stromal tumor on frozen section were diagnosed as thecoma, fibroma, sex cord stromal tumor and adult granulosa cell tumor respectively, on histopathology. Four discordant cases included 2 cases of Borderline surface epithelial tumor on frozen section diagnosed as Endometrioid carcinoma and Low grade serous carcinoma on histopathology, one case of normal elements on frozen section diagnosed as Mucinous adenocarcinoma on histopathology due to improper sampling of the lesional area; one case of Borderline serous tumor on frozen section diagnosed as Adenocarcinoma, possibly serous on histopathology. In a study done by Kediya et al, [95] the discordance in cases of borderline and benign cases was more as compared to malignant lesions similar to our study. Hashmi et al[101] opined that under-diagnosis can occur in tumors of borderline category which can be minimized by increased sampling on the frozen section. In a study done by Sharma J et al, sampling for frozen section analysis must include any solid, papillary excrescences or thickened cyst wall or thickened septa areas that are grossly suspicious and one should not overlook the area of hemorrhage and necrosis as just hemorrhagic cyst, because there may be clue to seromucinous carcinoma [109].

The sensitivity, specificity, positive predictive value and negative predictive value of frozen section for ovarian resections in our study were 84%, 100%, 100% and 82.6%. In a study done by Kediya et al, [95] the sensitivity, specificity, positive predictive value and negative predictive value were 75%, 97.6% ,90% and 93.2% respectively which were less as compared to our study.

SURGICAL MARGINS

In our study, we received 40 different surgical margins for various surgeries such as ureteric margins during cystectomy, eyelid margins during eyelid lesion excisions, total gastrectomy margins, pancreatic

margins during Whipple surgery, rectal margins for rectal carcinoma, cystic duct margins, bile duct margins, hepatic duct margin in case of cholangiocarcinoma, proximal and distal margins for cholangiocarcinoma, scalp margin for scalp lesion, esophageal margin for carcinoma stomach and femur margin for osteosarcoma. The spectrum of indications for margin evaluation in our study was bigger as compared to study done by Tamhane et al [1] in which margin assessment was received only for oral squamous cell carcinoma, carcinoma breast, carcinoma colon, squamous cell carcinoma of skin, basal cell carcinoma, and malignant peripheral nerve sheath tumor.

The mean age for patients undergoing these surgeries in our study was 57.5 years while in the study done by Ali J et al,[110] the mean age was a little lesser 51.6 years. In both above mentioned studies, the males were more than females. In our study the mean time taken for margin assessment by imprint cytology and frozen section was 23.9 minutes and 37.05 minutes respectively. Esbona K et al,[7] reported imprint cytology in less than 15 minutes.

In our study, out of 40 cases, 32 cases [80%] were negative for malignancy on imprint cytology, 7 cases [17.5%] were suspicious for malignancy as few of the cells showed nuclear enlargement and hyperchromasia. One case [2.5%] was diagnosed as positive for malignancy. Out of the 40 cases reported on Imprint cytology, 36 cases [90%] showed concordance with histopathology while 4 cases [10%] showed discordance. Discordant 4 cases were reported suspicious for malignancy on imprint cytology and were later found negative on histopathology. Reason for false positivity can be due to the fact that while making imprints due to streaking and crushing of cells thick clusters may be formed which may cause difficulty in analysing individual cell morphology. The sensitivity, specificity, positive predictive value and negative predictive value was 100%, 89.7%, 20% and 100% respectively in our study. Low positive predictive value was due to false positivity. Tamhane et al,[1] reported the sensitivity, specificity, PPV and NPV of imprint cytology for surgical margins as

46.51%, 90.76%, 56.56% and 84.62% respectively. In their study not even positive predictive but even the sensitivity value was lower.

In case of frozen section, for surgical margin status, out of 40 cases, 38 cases[95%] showed concordance with histopathology while 2 cases [5%] showed discordance. Two cases which were diagnosed as suspicious for malignancy had few scattered cells with nuclear hyperchromasia on frozen section and were labelled negative for malignancy on final histopathology. Yadav et al[111] opined that the false positive rate in margins may happen due to the presence of cauterized cells or contamination by tumor cells at margin while manipulation of tissue. The sensitivity, specificity, positive predictive value and negative predictive value was 100%, 94.8%, 33.3% and 100% respectively in our study.

Table 62-Comparison of various studies with our study for surgical margins

Author	Diagnostic modality	No. of cases	Sensitivity	Specificity	PPV	NPV
Tamhane et al[1]	Imprint cytology	103	46.15%	100%	100%	84.62%
	Frozen section	103	100%	98.71%	100%	100%
Jaiswal et al [5]	Imprint cytology	52	61.5%	87.7%	75%	79.2%
Mondal et al[112]	Imprint cytology	42	91.6%	100%	100%	96.7%
	Frozen section	42	91.6%	100%	100%	96.7%
Ali J et al [110]	Frozen section	251	88.81%,	94.84	95.20%,	88.10%,
Present study	Imprint cytology	40	100%	89.7%	20%	100%
	Frozen section	40	100%	94.8%	33.3%	100%

So in our study positive predictive value was lower as compared to other studies, while the rest of the parameters was concordant in all these studies. This could be attributed to only one case of positive margin in our study which would have led to disproportionate results especially in context of PPV and NPV.

ENDOMETRIUM

Endometrial tissue was sent in 27 cases to rule out any possibility of malignancy. The mean age in our study was 52.8 years which was slightly higher than the age in study done by Siva K et al [113] .The most common clinical indication for which endometrial tissue was sent was abnormal uterine bleeding which was similar to a study done by Siva K et al [113]. The mean time taken to diagnose imprint cytology and frozen section were 23.4 minutes and 34.9 minutes ,respectively .Imprint cytology diagnosis was divided into Non-neoplastic in 16 cases, neoplastic in 9 cases whereas 2 cases were deferred due to insufficient material on the slide due to presence of mucus, excess blood and overlapping scant cells. Out of 16 Non- neoplastic diagnosis,15 cases showed normal elements on imprint cytology and final histopathology, one case showed features of Benign endometrial lesion further diagnosed as Benign endometrial polyp. According to Kaur et al[72] in benign conditions accuracy was 96.2%.

Neoplastic cases in our study for imprint cytology included 3 cases as Suspicious for malignancy which were diagnosed as Benign endometrial polyp in 2 cases and normal elements in 1 case; 3 cases of Malignant neoplasm diagnosed as Leiomyosarcoma, High grade malignant neoplasm and Carcinosarcoma ;3 cases of Carcinoma as Carcinosarcoma and 2 as Endometrioid carcinoma. Discordant cases included 2 deferred cases and 3 cases of suspicious for malignancy. No case of malignancy was missed in cytology which is similar to the study done by Kaur et al [72]. Pallialil et al [98] correctly diagnosed all uterine specimens on imprint cytology as compared to results of our study where 4 cases were misinterpreted. The sensitivity, specificity,

Positive predictive value and Negative predictive value for imprint cytology were 100%,95.7% 66.67% and 100% in our study.

On frozen section, out of 27 cases,14 cases showed normal elements, one case was deferred due to insufficient material and showed hemorrhage mainly, whereas one case was diagnosed Benign endometrial polyp correctly. Among the malignant cases, all 6 cases were diagnosed correctly ; 3 cases of Malignant neoplasm as Leiomyosarcoma, high grade malignant neoplasm and Carcinosarcoma;3 cases of Endometrioid carcinoma as Endometrioid carcinoma and Carcinosarcoma. Discordant four cases included one case diagnosed as normal elements came out to be Benign endometrial polyp;1 deferred case;2 cases diagnosed as Endometrial hyperplasia which were diagnosed as Normal elements and Benign endometrial polyp respectively. The sensitivity, specificity, positive predictive value and negative predictive value for frozen section were 100%,100% 100% and 100%. In a study done by Aidos et al [70] correlation rate between frozen section and histopathology for histological subtype was 93.75% which was just similar to our study. FS is an ideal technique for intraoperative cases of endometrium ,however, imprint cytology displayed low specificity and PPV.

GALL BLADDER

Cholecystectomy specimens were received for primary diagnosis. We received a total of 14 specimens. The mean age was 55.4 years which was lower than a study done by Otero et al [84] in which the mean age was 69.2 years. Eight were females and 6 were males in our study, which was similar to study done by Otero et al [84] in which also there was female preponderance. The average time taken was 22.5 minutes which was higher than a study done by Otero et al [84] in which the mean time taken was 10 minutes. In our study all 14 diagnosis on imprint cytology were concordant with the final histopathological diagnosis in which the diagnosis were normal elements (3 cases), chronic cholecystitis (1 case), xanthogranulomatous cholecystitis (4

cases) and Carcinoma (6 cases). Hence sensitivity, specificity, Positive predictive value and negative predictive value were all 100%. In a study by Vallilengua C et al,[114] the imprint cytology was positive in 44 of 58 gallbladder carcinomas diagnosed, with a lower sensitivity of 75.9% as compared to our study and a specificity of 99.8% and only 1 case 0.2% was a false-positive; this was due to reactive changes. The positive predictive value was 97.8%, negative predictive value was 97.1%, and accuracy was 97.1%. There was insufficient or inadequate material in 4 cases.

On frozen section, 12 cases [78.5%] were concordant which included normal gall bladder (3 cases), chronic cholecystitis (1 case), xanthogranulomatous cholecystitis (4 cases) and adenocarcinoma (4 cases). One case diagnosed as Adenocarcinoma on histopathology was labelled Reactive on Frozen because the cell morphology was not clear and invasive focus could not be found. One case was labelled as mesothelial cell proliferation on Frozen section was later diagnosed as adenocarcinoma because of sampling error earlier. The sensitivity, specificity, Positive predictive value, negative predictive value were 66.67%, 100%, 100% and 80%. In a study done by Patkar et al,[65] the sensitivity, specificity, positive predictive value and negative predictive value were 88.3%,99.6%,99.4% and 92.7%. Thus our study had a lower sensitivity and lower negative predictive value compared to their study.

In assessment of gall bladder lesions, imprint cytology proved to be superior than FS with 100% sensitivity,100% specificity, 100% PPV and 100% NPV.

PARATHYROID GLAND

We received a total of 10 specimens to know the primary diagnosis. In all the cases, the diagnosis on imprint cytology and frozen section was concordant with the final histopathology as Parathyroid adenoma which were similar to a study done by Warpe et el[115] and Roazaik M et al. [116].

KNEE TISSUE

Four cases of knee tissue were received to know the evidence of infection post total knee replacement surgery. Study done by Wu C et al [117] showed similar results as our study. Using the criterion of 5 PMNs per HPF, an independent study by Spangehl et al[118]. demonstrated a sensitivity of 80% and a specificity of 94%, while another study, by Wong et al.[119] concluded a sensitivity of 93% and a specificity of 77%. Another study done by Wu C et al [117] showed similar results as our study.

BOWEL NODULE

Three cases of bowel nodule were received to look for evidence of metastasis, out of which two cases showed presence of metastatic carcinomatous deposits whereas one case was negative for malignancy on both imprint cytology and frozen section. All 3 cases (100%) were concordant with the final histopathological diagnosis. A study done by Mohamed A[120] showed a concordance rate of 96.8% and discordance rate of 3.2% in peritoneal biopsies in case of frozen section.

BUCCAL MUCOSA

Six cases of buccal mucosa were received for primary diagnosis. Out of which 5 cases were diagnosed as Squamous cell carcinoma on imprint cytology and frozen section both and one case as normal elements on both. These 6 cases were concordant with final histopathological diagnosis. In a study done by Adhya A et al[22] ,oral mucosa biopsies were analysed in which 201 were labelled malignant , 54 cases as suspicious for malignancy and 54 as benign on imprint cytology. In a study done by Demir B et al,[121] there was concordance between the frozen, positive intraoperative malignancy and the final histopathological diagnosis. The frozen, negative intraoperative malignancy and histopathology section for surgical margin showed similar findings.

CERVIX

We received 3 cases of cervix for primary diagnosis in which two cases showed presence of normal elements whereas one case showed presence of squamous cell carcinoma both on imprint cytology and frozen section. The results were concordant with the final histopathological diagnosis. In a study done by Pallialil et al[98] and Kediya et al[95], cervical biopsies were concordant with the final histopathological diagnosis.

FIBROID

Three cases of fibroids for primary diagnosis were received which were diagnosed as Spindle cell neoplasm on imprint cytology. These three cases were diagnosed as Leiomyoma on frozen section and histopathology. Pallialil et al [98] also received a case of fibroid and was diagnosed correctly on both imprint cytology and frozen section.

LIVER

All 3 cases were sent to look for of any metastatic deposit. All three cases showed normal liver parenchyma on imprint cytology, frozen section and histopathology. Study done by Lechago et al [122] showed comparison between the appearance on frozen section of a cholangiocarcinoma with that of a biliary hamartoma. The cholangiocarcinoma showed marked irregularity of the ducts, cellular atypia, and nuclear pleomorphism and hyperchromasia whereas showed regular, dilated ducts lined by a single layer of cells with a bland cytologic appearance.

OMENTUM

All 3 cases were sent to detect any metastasis. Two cases showed only fibrofatty stromal fragments whereas one case was diagnosed positive for malignancy. All the cases were concordant with histopathology. Mohamed A[120] showed a concordance rate of 96.8% and discordance rate of 3.2% in peritoneal biopsies in case of frozen section.

PAROTID GLAND

Three cases of parotid gland were received for primary diagnosis.

One case was diagnosed as cyst on imprint cytology was diagnosed as Benign cyst and finally Retention cyst on histopathology. Second case diagnosed as Suspicious for malignancy on imprints was diagnosed as Neoplasm on frozen section and further on histopathology as Mucoepidermoid carcinoma. Third case diagnosed as Suspicious for malignancy was diagnosed as tumor on frozen section and Acinic cell carcinoma on histopathology. Naveed H [123] also diagnosed case of Acinic cell carcinoma in parotid gland which was received for primary diagnosis on imprint cytology.

BRAIN

Two cases of brain were received for primary diagnosis. One case was diagnosed as positive for malignancy on imprint cytology which was further diagnosed as Meningioma on both frozen section and histopathology. Other case was diagnosed as tumor on imprint cytology and High grade tumor on frozen section and was finally diagnosed as Glioblastoma on final histopathology. Many studies on brain imprint cytology have been done including Koyuncuer et al [124] which analysed 93 brain biopsies, Zulkarnain S et al [28] analysed 22 cases of Glioma and Jain S et al[125] which analysed 53 cases of brain tumors. The results of imprint cytology and frozen section both are almost equal in case of brain specimens.

CERVICAL LYMPH NODE

Two cases of cervical lymph node were received for primary diagnosis. One case was diagnosed as Granulomatous inflammation on histopathology and showed showed histiocytic collections on imprint cytology while frozen section showed epitheloid cell granuloma. Second case was diagnosed as Round cell tumor on imprint cytology but final histopathology showed metastatic carcinomatous deposits of small cell carcinoma.

TONGUE

Three cases of tongue were received for primary diagnosis. Two cases were diagnosed as squamous cell carcinoma on imprint cytology and frozen section which was given squamous cell carcinoma on histopathology whereas one case showed normal elements on all three modalities. In a study done by Geeta L et al [126], out of 30 biopsies ,24 were positive for malignancy and accuracy was 93.2% for imprint cytology. Miyawaki et al [127] evaluated the usefulness of frozen section method in treatment outcomes of oral squamous cell carcinoma in patients treated prior to (Group 1) and after (Group 2) the introduction of our frozen section method. The recurrence rate of the primary lesions was high (17.3%) in Group 1, but decreased significantly in Group 2 (6.9%).

EYELID LESION

Two eyelid cases were received for primary diagnosis in which one case showed normal eyelid elements on imprint cytology, frozen section and histopathology whereas other showed features of malignancy on imprint cytology which were further diagnosed as Malignant epithelial tumor on frozen section and Eccrine carcinoma on histopathology. Paridaens D et al[128], for eyelid tumors studied frozen section controlled (FSC) surgical excision of eyelid tumours, followed by histopathological confirmation with permanent fixed section in which tumours were excised with a cold blade or scissors with at least 2 to 10 m m margins clinically free from neoplasia, according to the tumour type, and frozen section examination of surgical margins was employed for the histologic confirmation prior to eyelid defect reconstruction. Hence intraoperative diagnosis plays an important role in these surgeries.

URINARY BLADDER

Mostly for cystectomies, ureteric margins were received but we also received two cases of urinary bladder for primary diagnosis and whether the underlying muscularis was involed by tumor or not. Both

cases on imprint cytology and frozen section showed presence of tumor and on final histopathology, diagnosis of Invasive papillary urothelial carcinoma was made. Miyamoto et al[129] discussed that dysplastic changes in the ureteral and urethral margins is often challenging because of histological frozen artifact, as well as associated inflammation, treatment effect and/or cautery artifact. Laukhtina et al[130] discussed frozen section analysis of ureteral margins and the pooled sensitivity and specificity were 0.77 and 0.97, respectively.

BREAST LUMP

One case of breast lump for primary diagnosis was submitted which was diagnosed positive for malignancy on imprint cytology and Invasive duct carcinoma on frozen section and histopathology, hence was concordant. In a study done by Mahadevappa et al [91] ,sensitivity, specificity and accuracy of imprint cytology were 100%, 96.43% and 98.36% and for frozen section were 100%, 96.55% and 98.39%.

Other tissues which were received for intraoperative analysis were lung tissue, mandible ,nose, thigh, scar site ectopic and anterior abdominal cyst wall. Imprint cytology, frozen section and histopathology were concordant in all these cases.

SUMMARY AND CONCLUSION

Intraoperative imprint cytology and frozen section are used by the surgeon to know urgently about the lesion while the patient is on the operating table. Imprint cytology is a faster and inexpensive technique which can be used in remote areas where facilities of cryostat is not available. Frozen section is a rapid method that can be used to harden tissue sufficiently to allow thin sectioning. The examination report of frozen section is conveyed as soon as possible to the operating surgeon via telephone or intercoms as the result will greatly influence the surgeon's intra-operational decision. The pathologist has to arrive at a correct decision in a shorter duration under pressure based on his experience, judgement and the knowledge of his specialty and clinical medicine. Both imprint cytology and frozen section are two independent techniques which help us in achieving high accuracy when used simultaneously. The findings in our study were:

1. The commonest age group who underwent imprint cytology and frozen section was between 41 to 50 years comprising of 79 cases [28.1%].
2. Females were more in our study constituting 226 cases [80.4%] with a male to female ratio of 1:4.1.
3. Frozen section and imprint cytology were ordered in 127 cases [45.19%] for primary diagnosis, while in 108 cases [38.4%] they were done to look for evidence of metastasis, in 40 cases [14.23%] they were sent to assess the resected margin status and in 6 cases [2.13%] to look for infection.
4. For imprint cytology, in 140 cases [49.82%] the reporting time was less than 20 minutes while in 126 cases [44.84%] the revert time was 21-40 minutes. In 15 cases [5.33%], reporting time was more than 40 minutes. Mean time taken was 22.63 minutes. Least amount of time taken was 10 minutes. Maximum time taken was 48 minutes in 1 case.
5. For frozen section, in majority of the cases, i.e. 197 cases [70.1%] ,the revert time was between 20 to 40 minutes while in 66 cases

[23.5%] the revert time was 41-60 minutes. In 10 cases [3.6%], revert time was less than 20 minutes but in 8 cases [2.8%], revert time was more than 60 minutes. Mean time taken was 35.45 minutes .Least time taken was 15 minutes. Maximum time taken was 77 minutes in 1 case of parathyroid adenoma in which there was suspicion of malignancy was finally given as parathyroid adenoma on frozen section.

6. Maximum cases were received for sentinel lymph nodes [34.9%] followed by ovary [15.65%], surgical margins [14.2%], endometrium [9.6%] and gall bladder [4.9%].
7. In case of imprint cytology, 179 cases[63.7%] were Non-neoplastic,98 cases [34.9%] were non-neoplastic and 4[1.4%] cases were deferred whereas in case of frozen section 182 cases[64.8%] were Non-neoplastic,96 cases [34.2%] were non-neoplastic and 4[1.0%] cases were deferred.
8. In case of imprint cytology,259 cases [92.2%] were concordant, 22 cases [7.8%] were discordant with final histopathological diagnosis whereas in case of frozen section,264 cases [93.9%] were concordant, 17 cases [6.04%] were discordant with final histopathological diagnosis.
9. For imprint cytology, concordance rate was maximum for gall bladder cases[100%] and minimum for Endometrium[81.4%] whereas in case of frozen section, concordance was maximum for sentinel lymph nodes [98.9%] and minimum for ovary[81.81%].
10. For imprint cytology, discordance was maximum for endometrium [18.5%] and minimum for gall bladder[0%] whereas for frozen section discordance was maximum for ovary [18.18%] and minimum for sentinel lymph nodes[1.02%].
11. In case of imprint cytology, Sensitivity was maximum for surgical margins[100%],endometrium[100%] and gall bladder [100%] and minimum for sentinel lymph nodes[81.8%] whereas for frozen section, sensitivity was maximum for sentinel lymph nodes [100%],margins[100%] and endometrium[100%] and minimum for gall bladder [66.67%].

12. In case of imprint cytology, specificity was maximum for gall bladder[100%] and ovary [100%] and minimum for endometrium[85.7%], whereas for frozen section, specificity was maximum for ovary[100%] , endometrium [100%] and gall bladder[100%] and minimum for surgical margins [94.8%].
13. In case of imprint cytology, Positive predictive value was maximum for ovary [100%] and gall bladder [100%] and minimum for surgical margins[20%] whereas for frozen section , positive predictive value was maximum for ovary[100%], endometrium[100%] and gall bladder [100%] and minimum for margins [33.3%].
14. In case of imprint cytology, Negative predictive value was maximum for endometrium [100%] ,surgical margins [100%] and gall bladder [100%] and minimum for ovary [81.8%] whereas for frozen section , negative predictive value was maximum for sentinel lymph nodes [100%],surgical margins [100%] and endometrium[100%] and minimum for gall bladder [80%].
15. Overall sensitivity, specificity, PPV, NPV of imprint cytology were 91.7%, 95.05%, 90.8% and 95.5% and for frozen section were 94.7%,98.4%,96.7% and 96.7%.

Hence from our study we conclude that imprint cytology can be used as an adjunct to frozen section for better diagnosis. Imprint cytology is a boon for resource-deprived settings and frozen section compliments it in tertiary care centres for intraoperative diagnosis and in determining the extent of surgical intervention required. The major advantage of imprint cytology over frozen section is that it has lesser turnover time than frozen section. Tumors with a large necrotic component and very small samples pose challenges in evaluation due to high sampling errors and technical difficulty respectively.

Suggestions to improve accuracy and decrease discordance

1. Strict adherence to quality control measures and periodic audits.
2. Interdisciplinary communication to decrease sampling and interpretation errors
3. Identifying the correct indication for performing frozen section.

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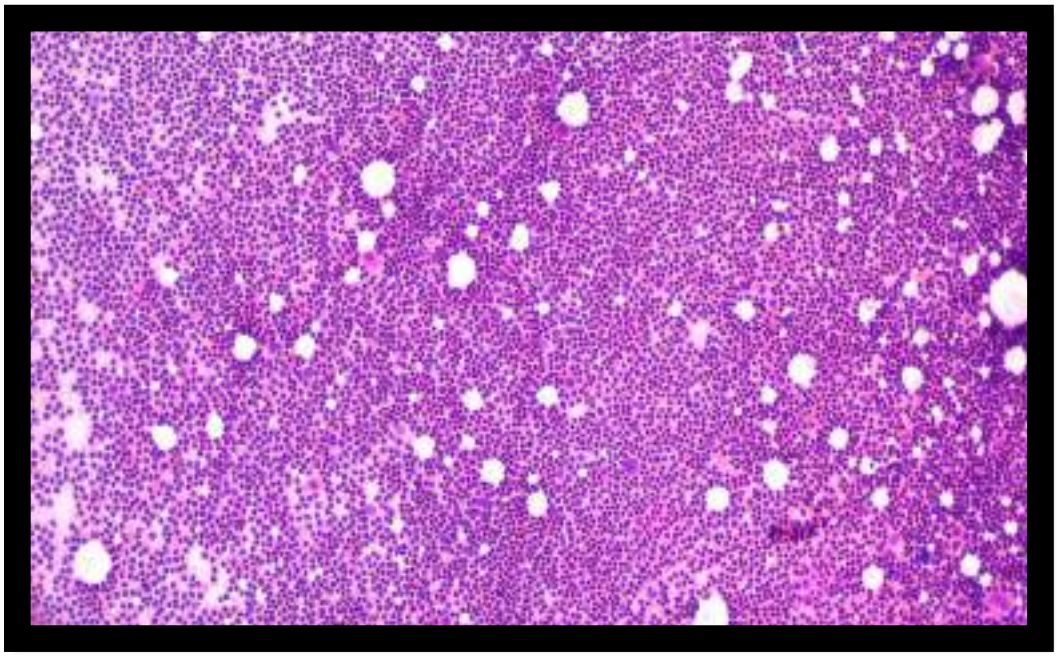
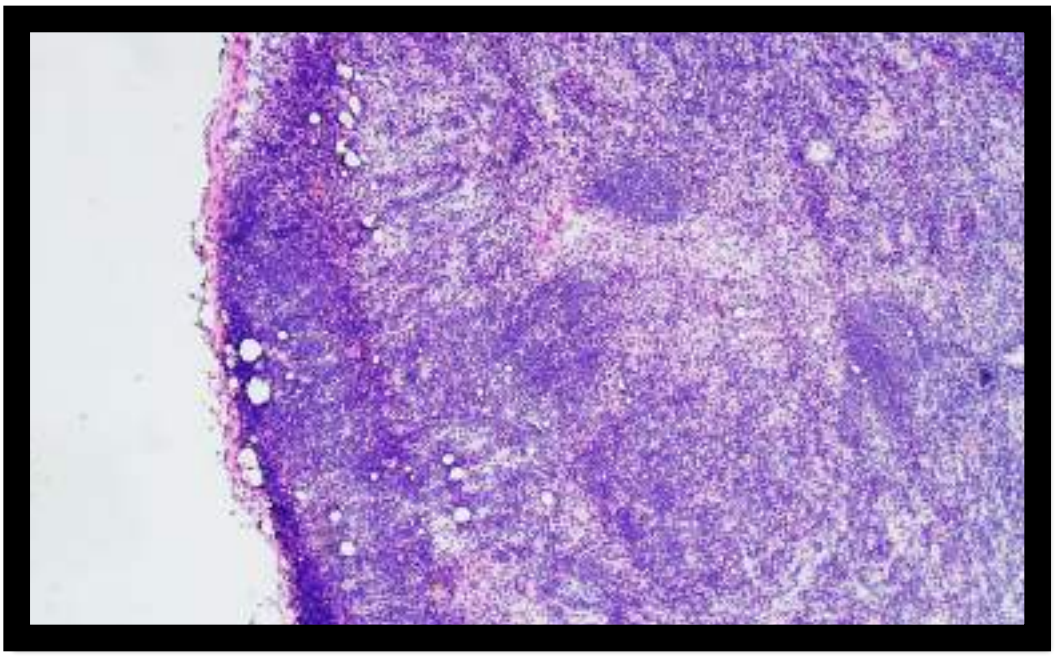
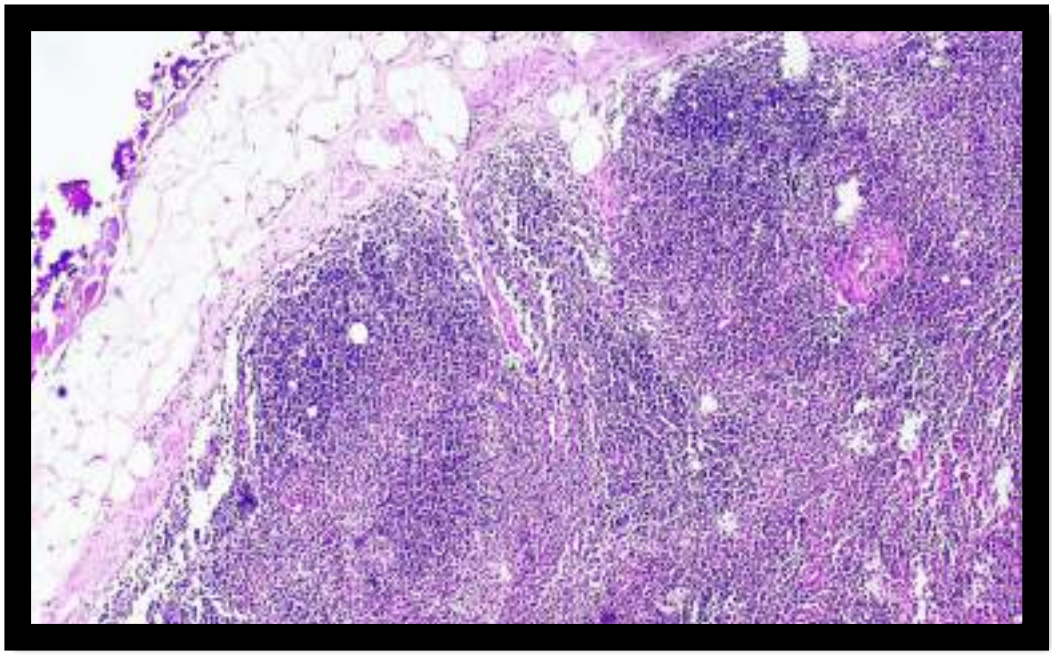
SENTINEL LYMPH NODE



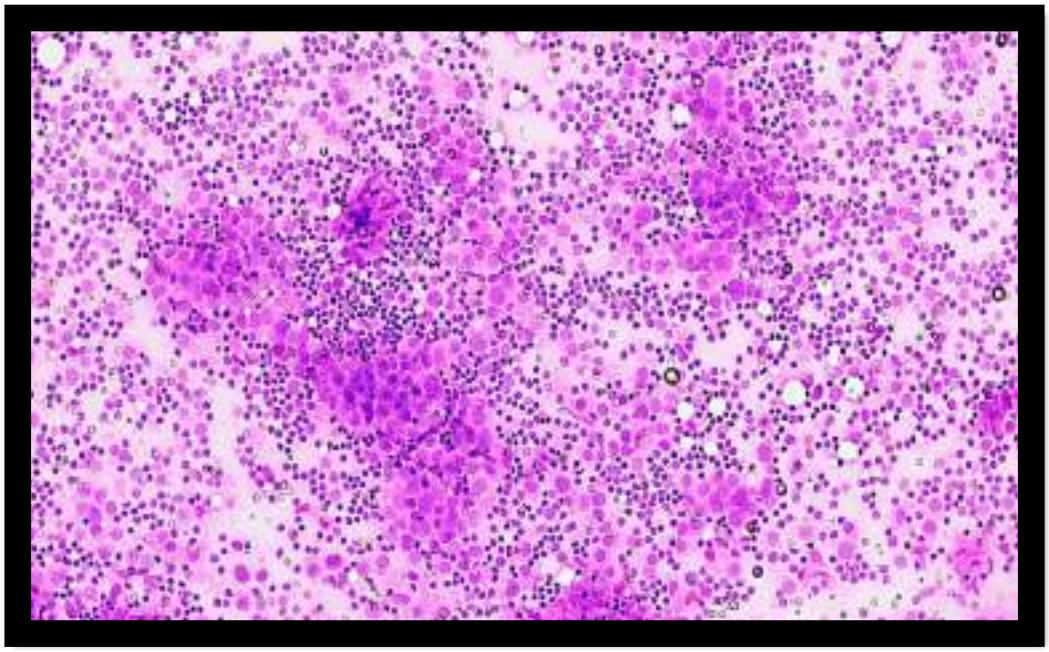
Picture No. 1: Reactive Hyperplasia, Imprint cytology: Photomicrograph of sentinel lymph node shows reactive lymphoid cells in varying stages of maturation seen as centrocytes, centroblasts, immunoblasts and lymphocytes. [H&E, 100X]



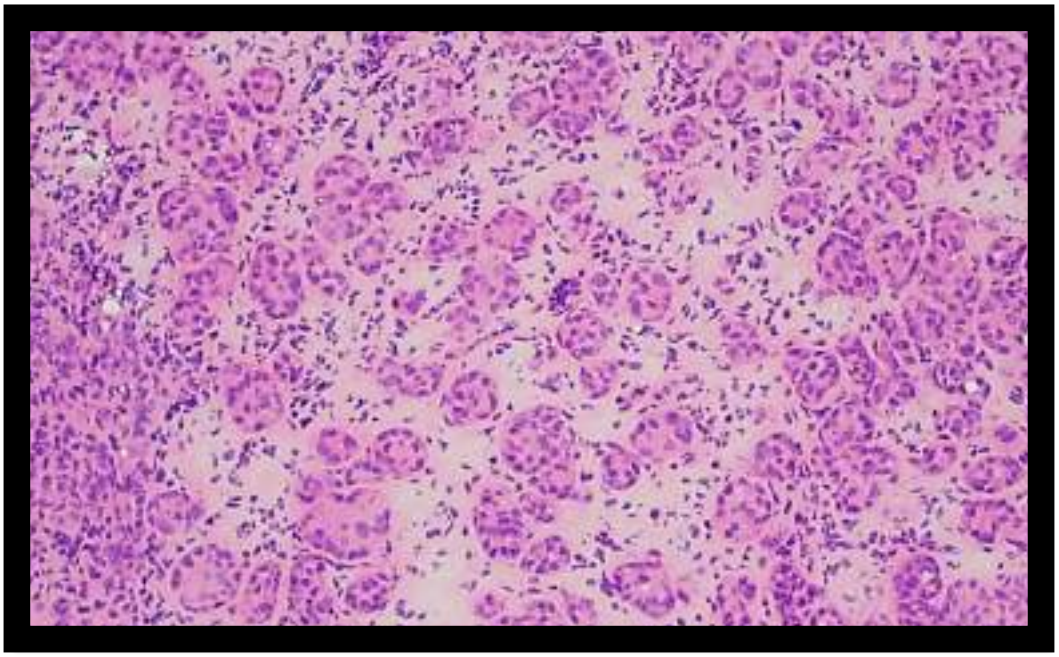
Picture No. 2: Reactive Hyperplasia, frozen section: Photomicrograph of sentinel lymph node showing maintained architecture and presence of reactive lymphoid cells along with reactive germinal centres at right. [H&E, 100X]



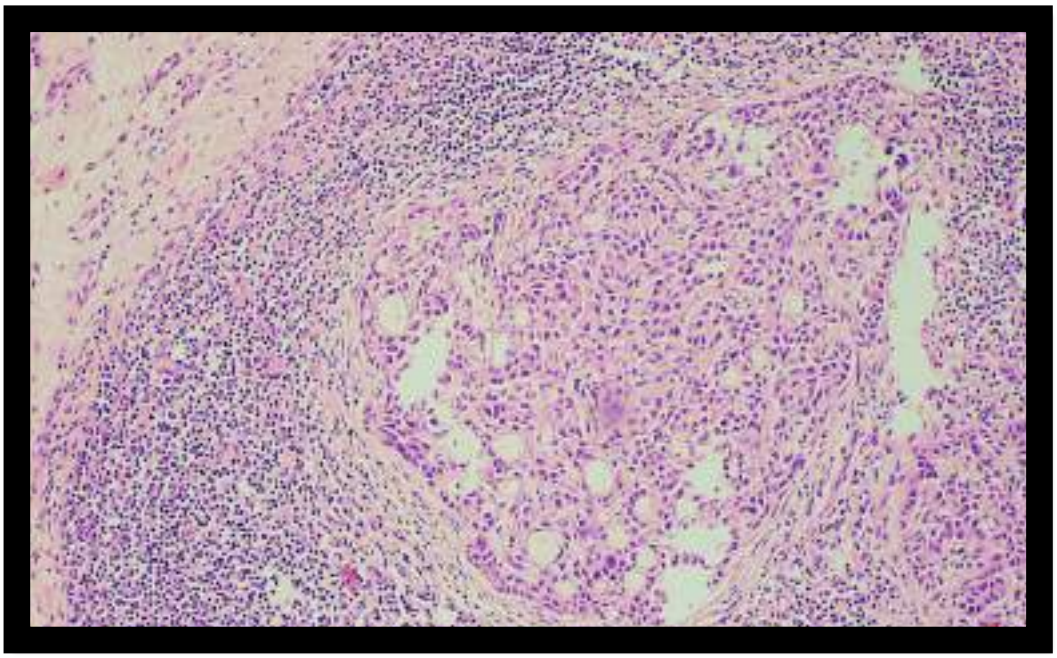
Picture No. 3: Reactive hyperplasia, histopathology: Photomicrograph of sentinel lymph node showing maintained architecture with presence of reactive lymphoid cells. [H&E,100X]



Picture No. 4: Metastatic carcinomatous deposits,imprint cytology: Photomicrograph of sentinel lymph node showing scattered clusters of atypical cells with high N/C ratio fine chromatin and moderate amount of cytoplasm. [H&E, 100X]

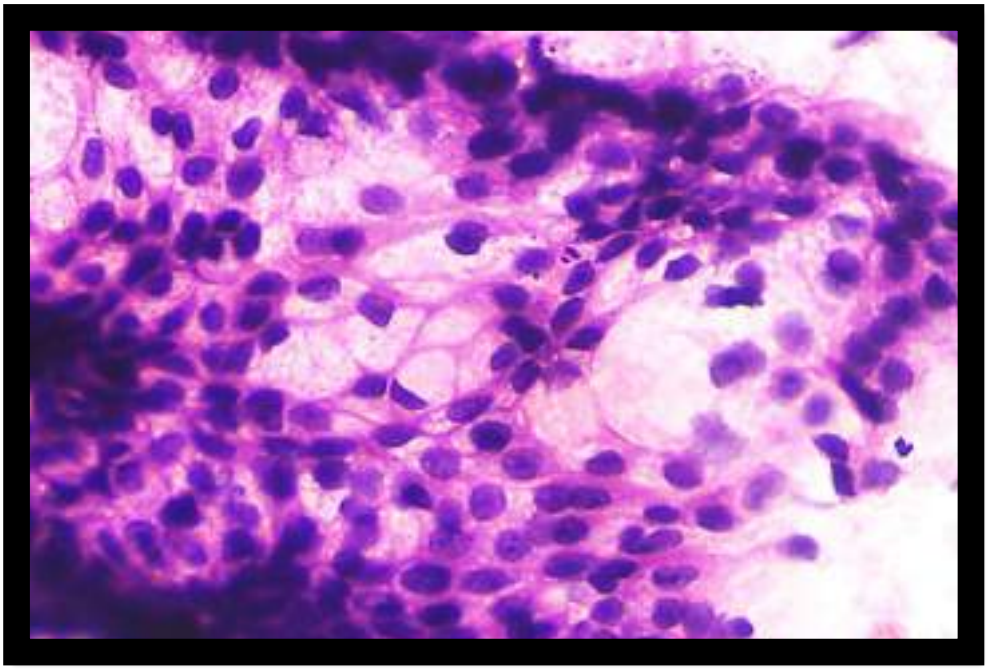


Picture No. 5: Metastatic carcinomatous deposits, frozen section: Photomicrograph of sentinel lymph node showing presence of glands of atypical cells exhibiting nuclear pleomorphism and hyperchromasia in a lymph node. [H&E,100X]

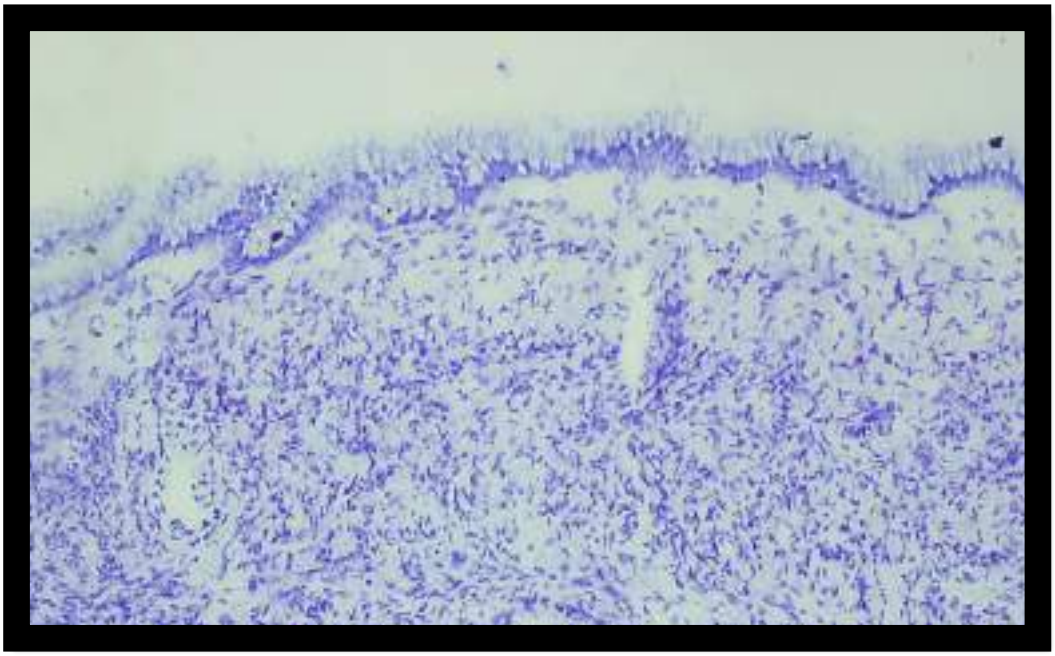


Picture No. 6: Metastatic carcinomatous deposits, histopathology: Photomicropgraph of sentinel lymph node showing presence of nest of tumor cells arranged in sheets and glands exhibiting nuclear pleomorphism and hyperchromasia and scant amount of cytoplasm. [H&E,100X]

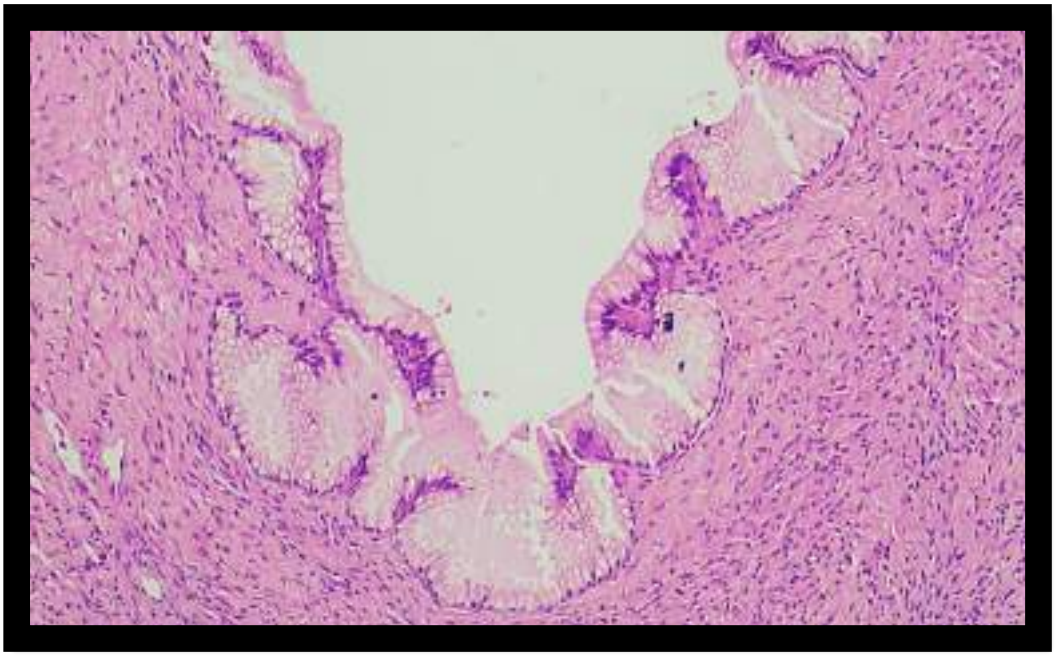
OVARY



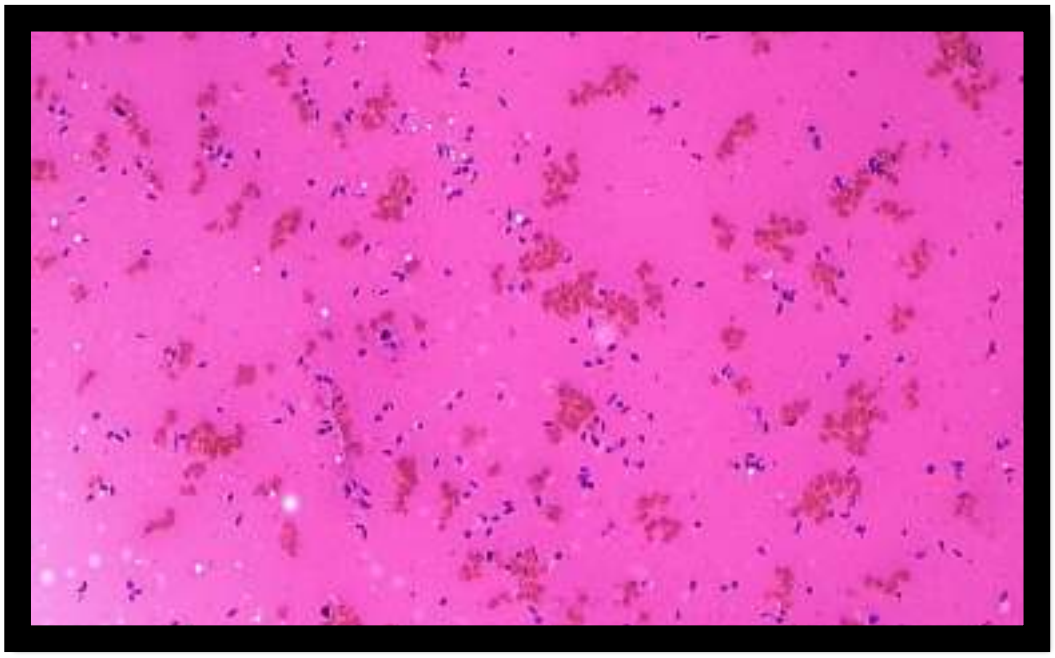
Picture No. 7: Mucinous neoplasm, imprint cytology: Photmicrograph of ovary showing sheets of mucin secreting cells having abundant intracytoplasmic apical mucin and basally located nuclei. [H&E,400X]



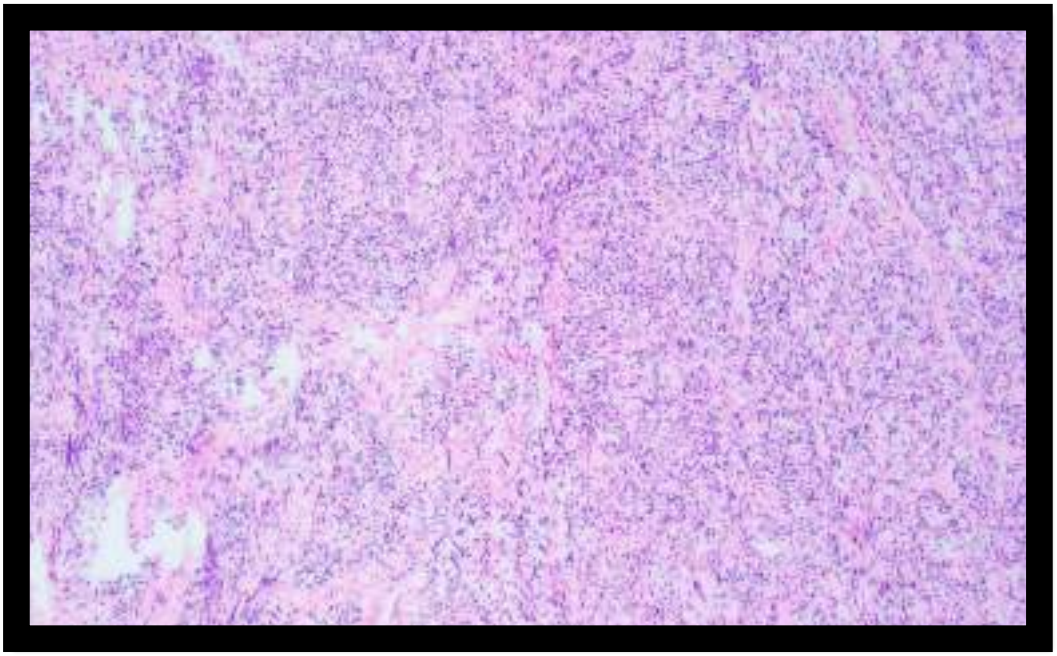
Picture No. 8: Mucinous cystadenoma, frozen section: Photomicrograph of ovary showing a single lining of mucin secreting epithelium with apical mucin and basally located nuclei. [Toluidine blue,100x]



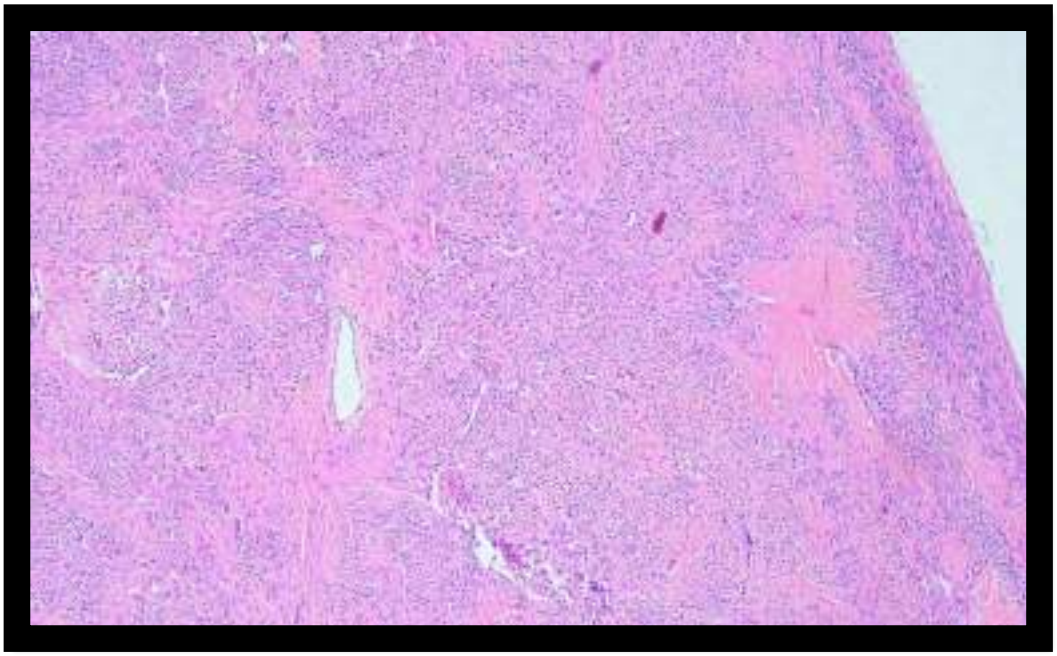
Picture No.9: Mucinous cystadenoma, histopathology: Photomicrograph of ovary showing presence of a single layer of mucin secreting epithelium having apical mucin and basally located nuclei. [H&E,100X]



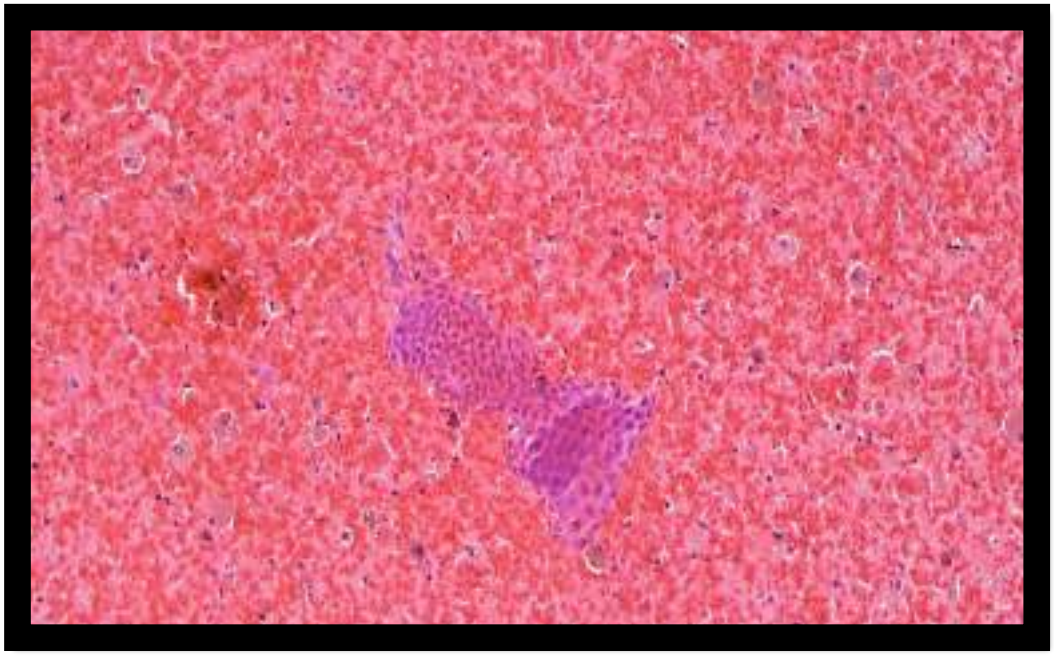
Picture No. 10: Spindle cell neoplasm, imprint cytology: Photomicrograph shows scattered elongated cells having hyperchromatic nuclei and scant cytoplasm. [H&E,100X]



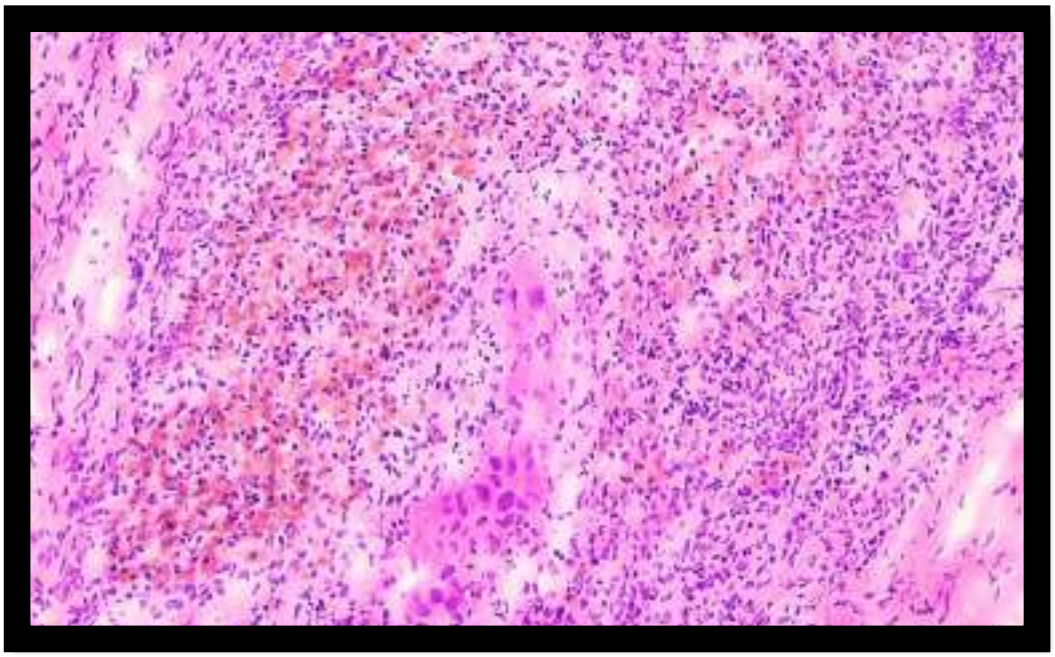
Picture No.11: Sex cord stromal tumor, frozen section: Photomicrograph of ovary shows a cellular tumor composed of elongated hyperchromatic nuclei and indistinct cytoplasmic boundaries. [H&E,100X]



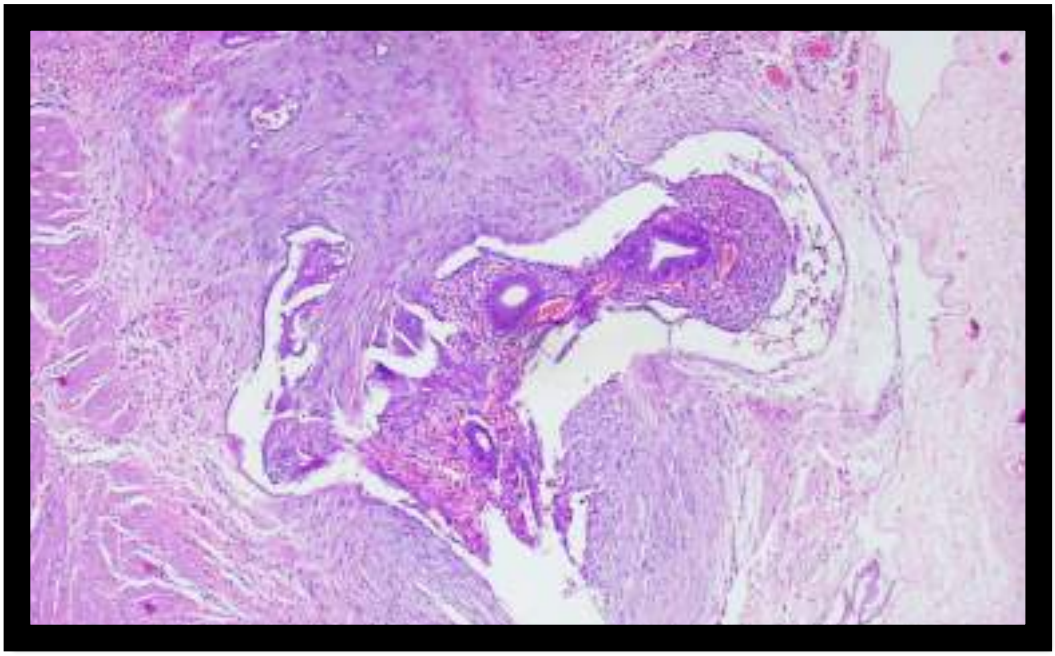
Picture No.12: Thecoma, histopathology: Photomicrograph from ovary showing a well encapsulated tumor having spindle shaped cells with elongated nuclei and moderate amount of cytoplasm separated by fibrocollagenous stroma. [H&E,100X]



Picture No.13: Endometriosis, imprint cytology: Photomicrograph from ovary showing hemorrhagic smears having cluster of endometrial stromal cells along with many scattered hemosiderin laden macrophages. [H&E,100X]

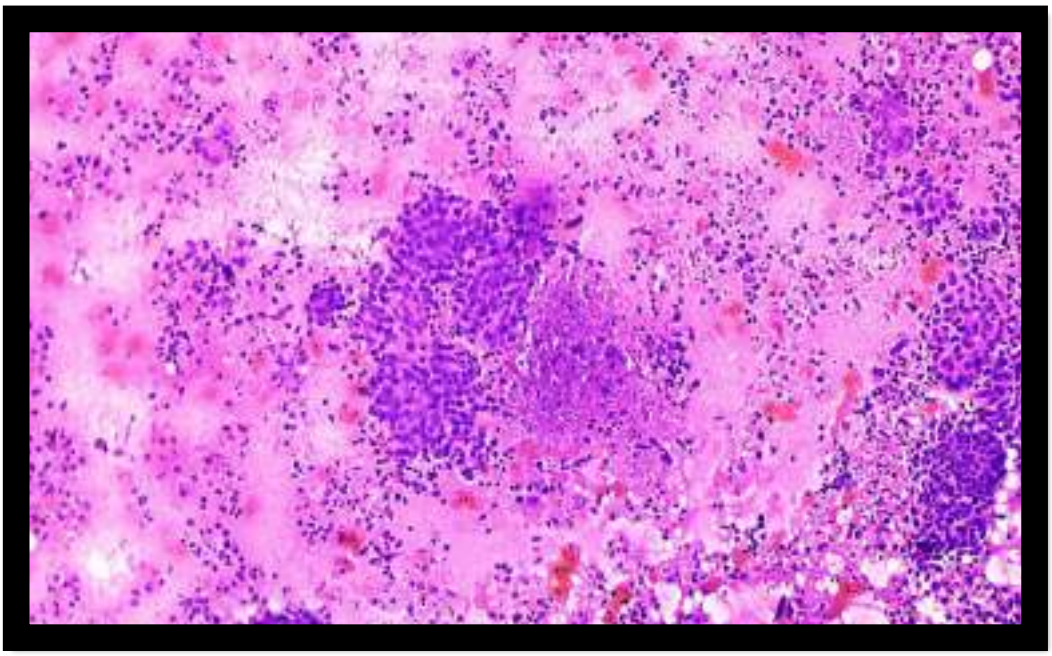


Picture No. 14: Endometriosis, frozen section: Photomicrograph from ovary showing endometrial gland with presence of numerous hemosiderin laden macrophages. [H&E,100X]

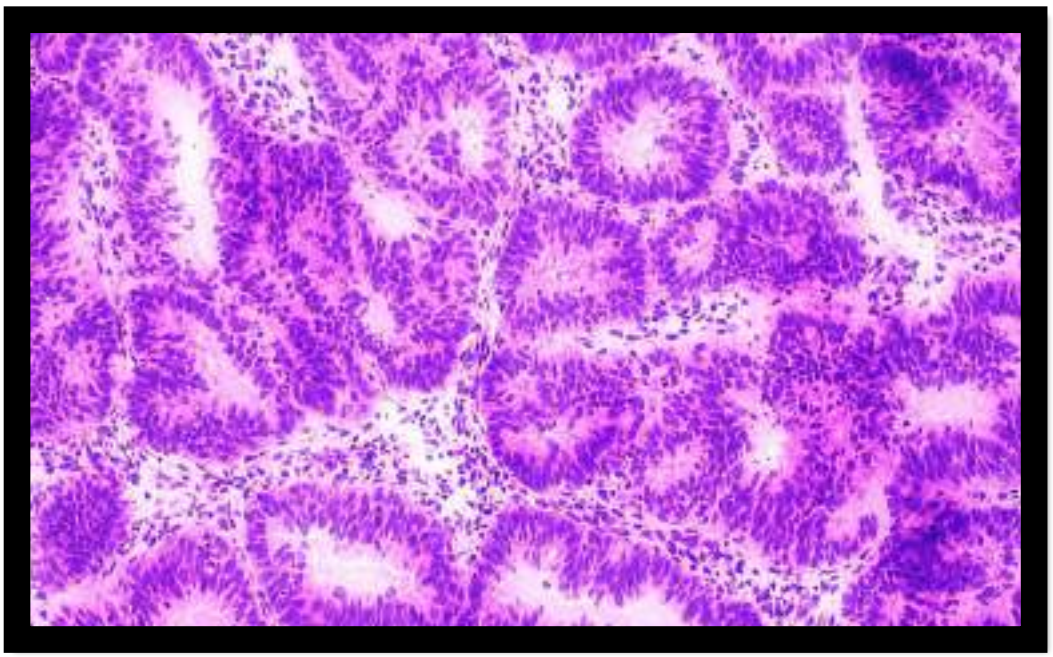


Picture No.15: Endometriosis, histopathology: Photomicrograph showing ovarian stroma within which as present endometrial glands and stroma with area of hemorrhage. [H&E,100X]

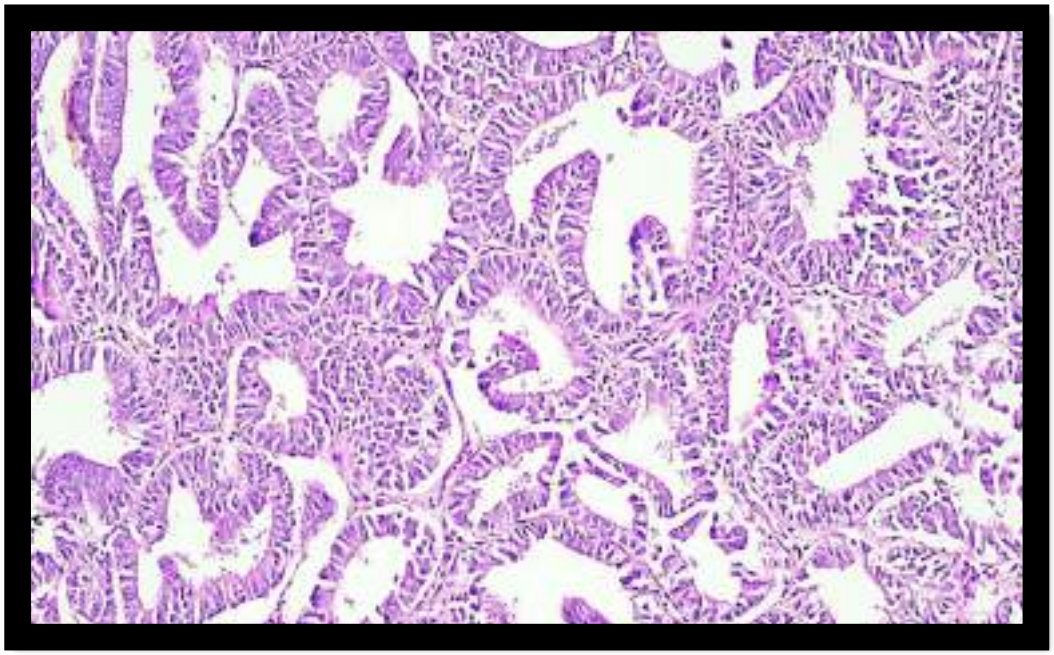
ENDOMETRIUM



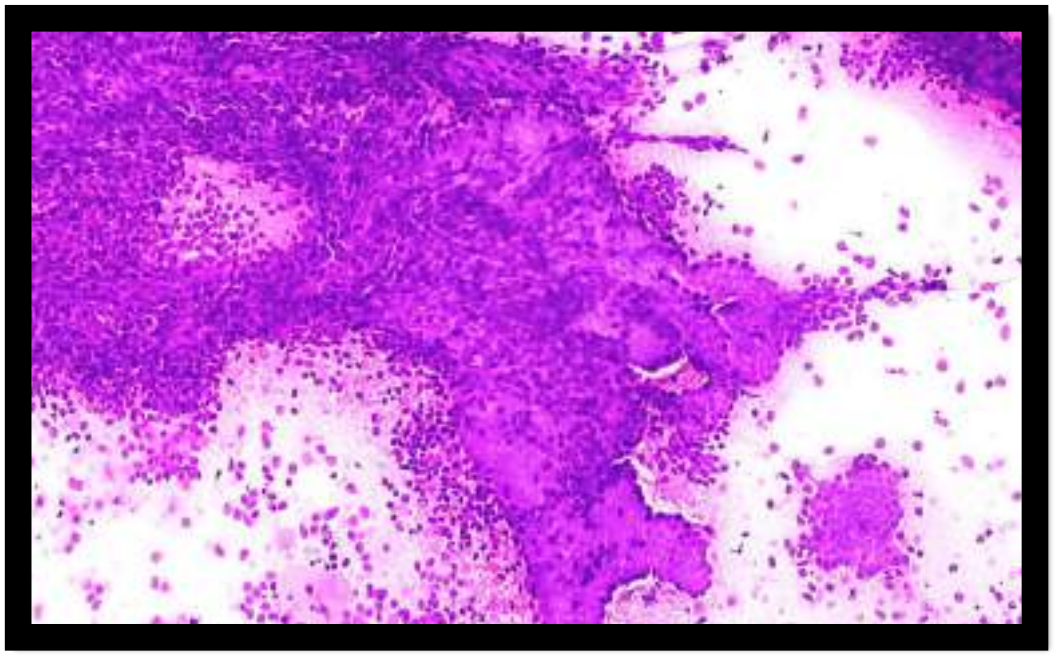
Picture No.16: Endometrial Endometrioid carcinoma, imprint cytology: Photomicrograph from endometrium showing tumor cells arranged in glandular configuration exhibiting clustering with pleomorphic hyperchromatic nuclei and scant amount of cytoplasm. Background shows areas of necrosis with degenerating inflammatory cells. [H&E,100X]



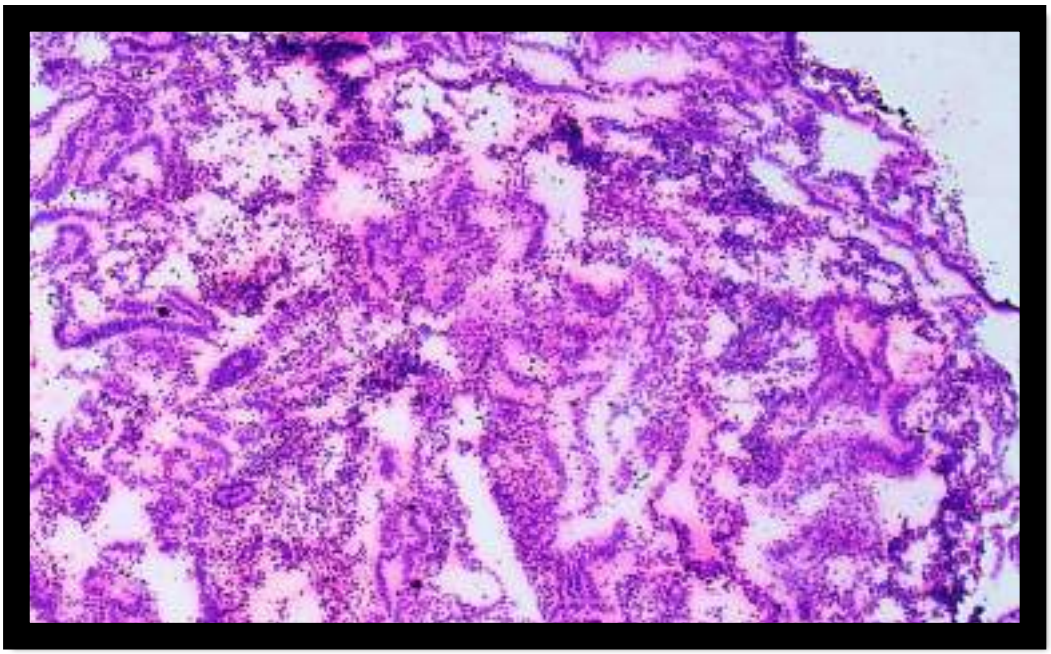
Picture No.17: Endometrial Endometrioid carcinoma, frozen section: Photomicrograph from the endometrium shows presence of neoplastic endometrial glands with scant stroma in between.
The tumor cells exhibit marked nuclear pleomorphism and hyperchromasia. [H&E,100X]



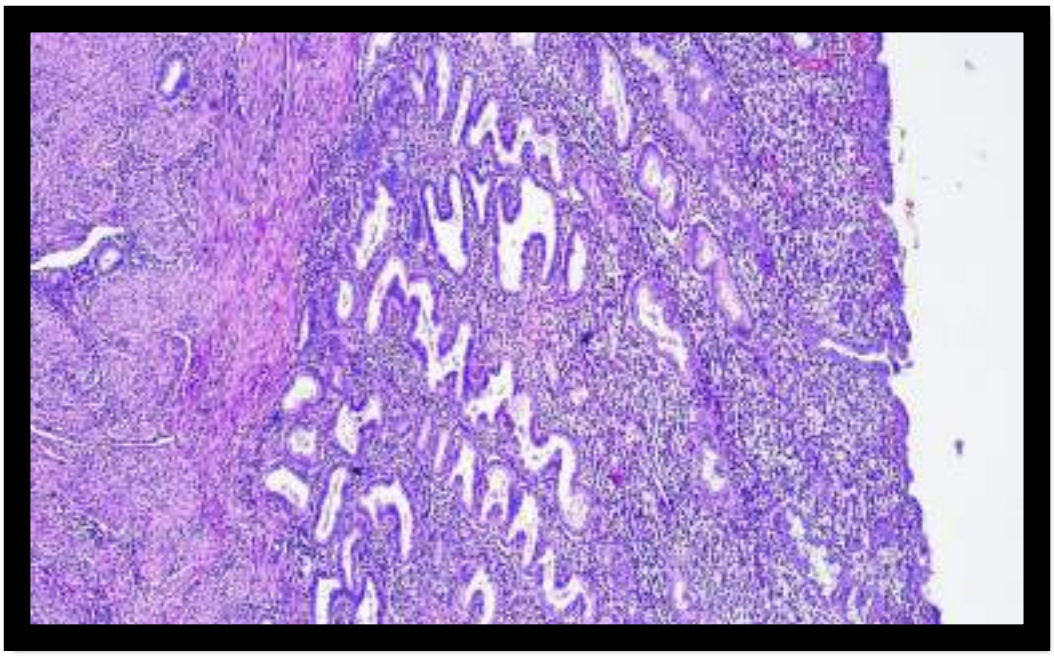
Picture No.18: Endometrial Endometrioid carcinoma,histopathology: Photomicrograph from endometrium shows variably sized neoplastic endometrial glands with little intervening stroma. Individual tumor cells have pleomorphic vesicular nuclei and scant amount of cytoplasm. [H&E,100X]



Picture No. 19: Suspicious for malignancy, imprint cytology: Photomicrograph from endometrium shows highly cellular smears having papillaroid configuration of cells as well as singly scattered. Few of the cells show nuclear enlargement. [H&E,100X]

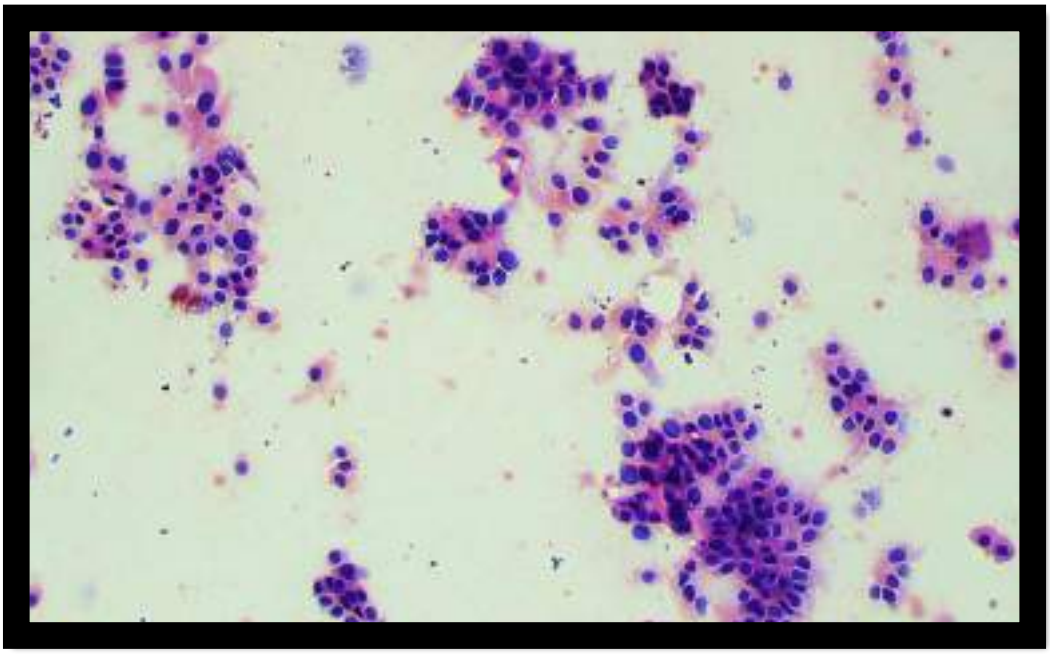


Picture No.20: Endometrial hyperplasia, frozen section: Photomicrograph from endometrium shows presence of endometrial glands and stroma with gland to stroma ratio of >3:1.No evidence of malignancy seen. [H&E,100X]

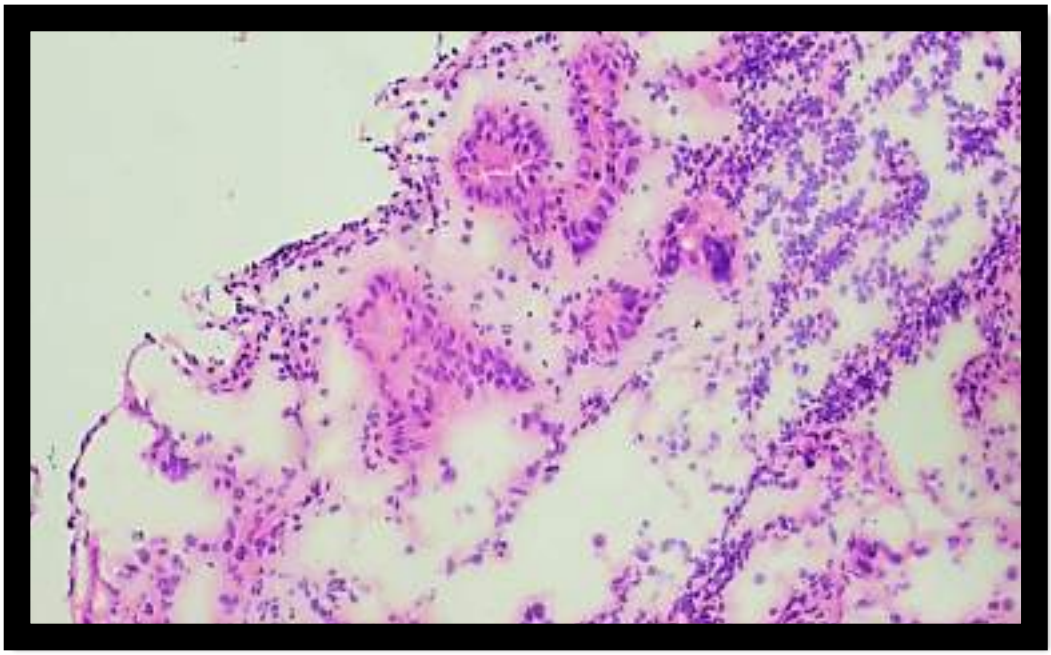


Picture No.21: Secretory endometrium, histopathology: Photomicrograph from endometrium shows endometrial glands in secretory phase having corkscrew appearance. The stroma is edematous. No evidence of malignancy seen. [H&E,100X]

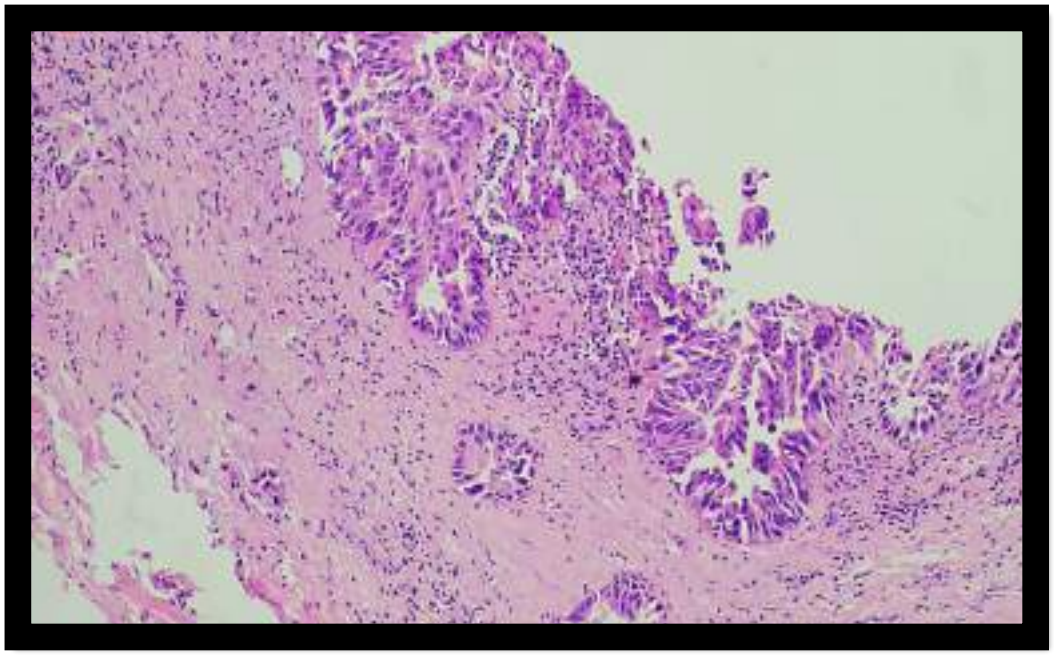
SURGICAL MARGINS



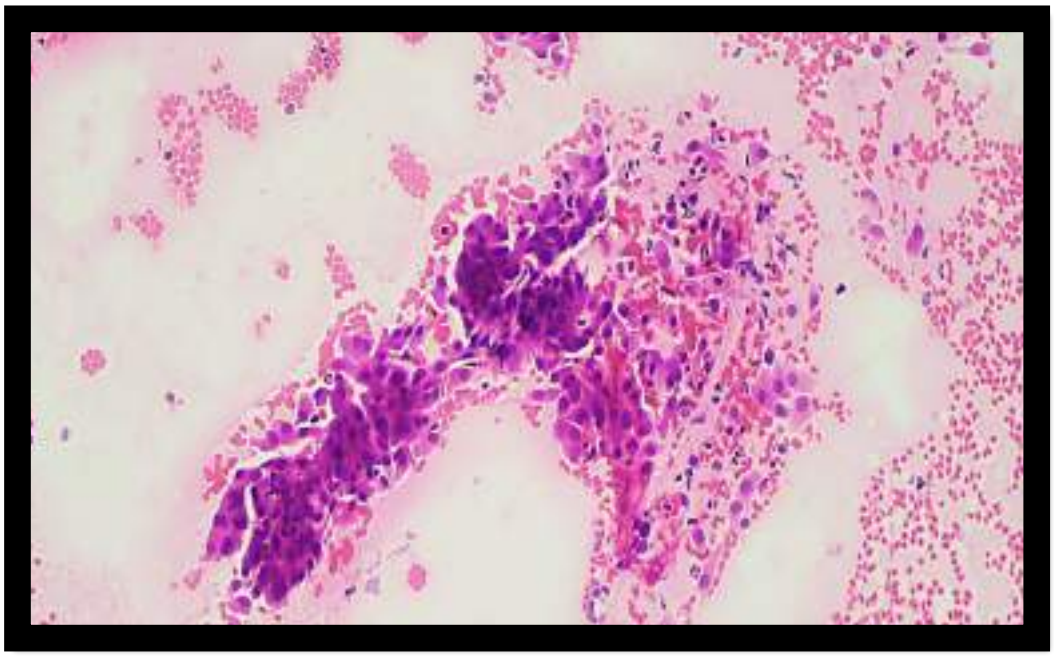
Picture No. 22: Positive for malignancy, imprint cytology: Photomicrograph from bile duct surgical margin shows clusters and occasional glands of neoplastic cells having high N/C ratio, irregular nuclear contours, coarse chromatin and scant amount of cytoplasm. [H&E, 100X]



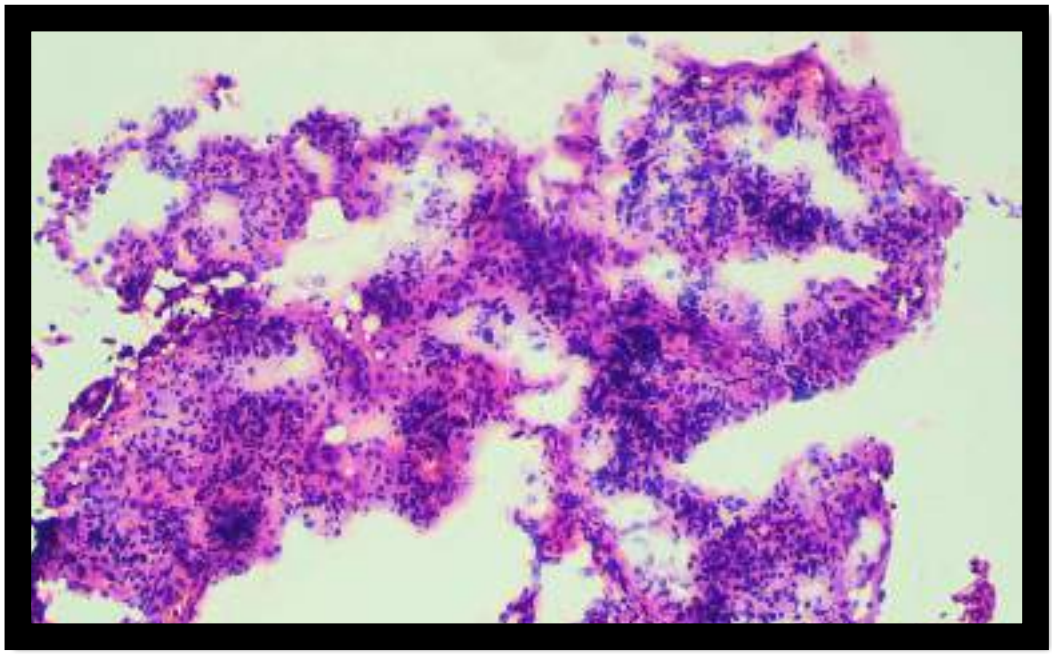
Picture No. 23: Positive for malignancy, frozen section: Photomicrograph from bile duct surgical margin showing neoplastic glands within the wall of bile duct. [H&E, 100X]



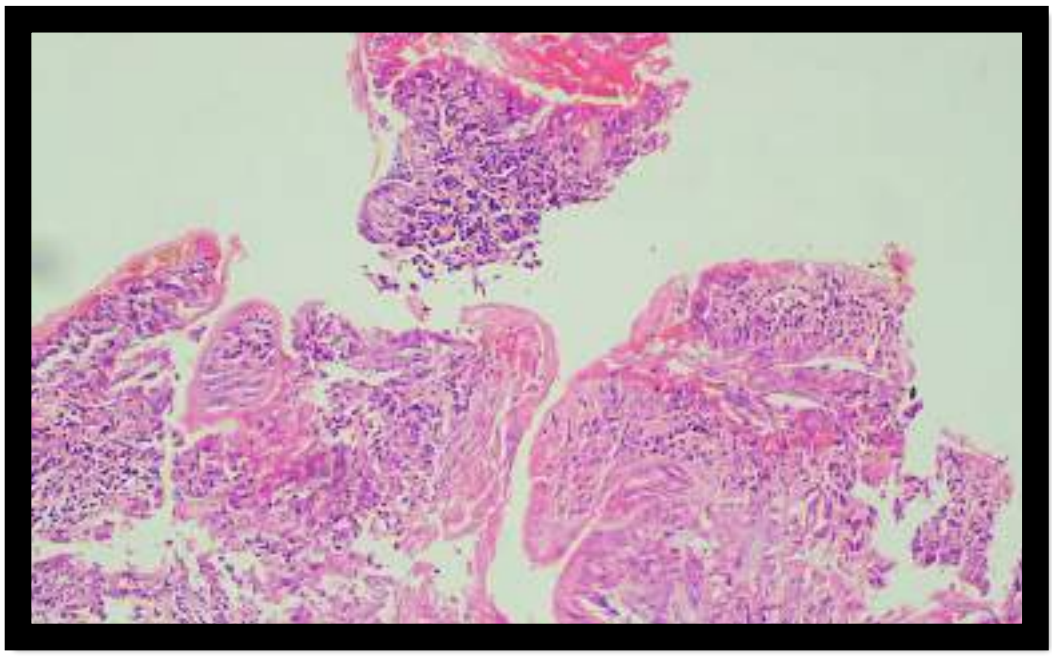
Picture No.24: Adenocarcinoma, histopathology: Photomicrograph from bile duct margin showing neoplastic glands in the wall of bile duct.The glands have hyperchromatic pleomorphic nuclei with moderate amount of cytoplasm. [H&E,100X]



Picture No.25: Suspicious for malignancy, imprint cytology: Photomicrograph from eyelid margin showing clustering of cells appearing hyperchromatic giving false interpretation of malignancy. [H&E, 100X]

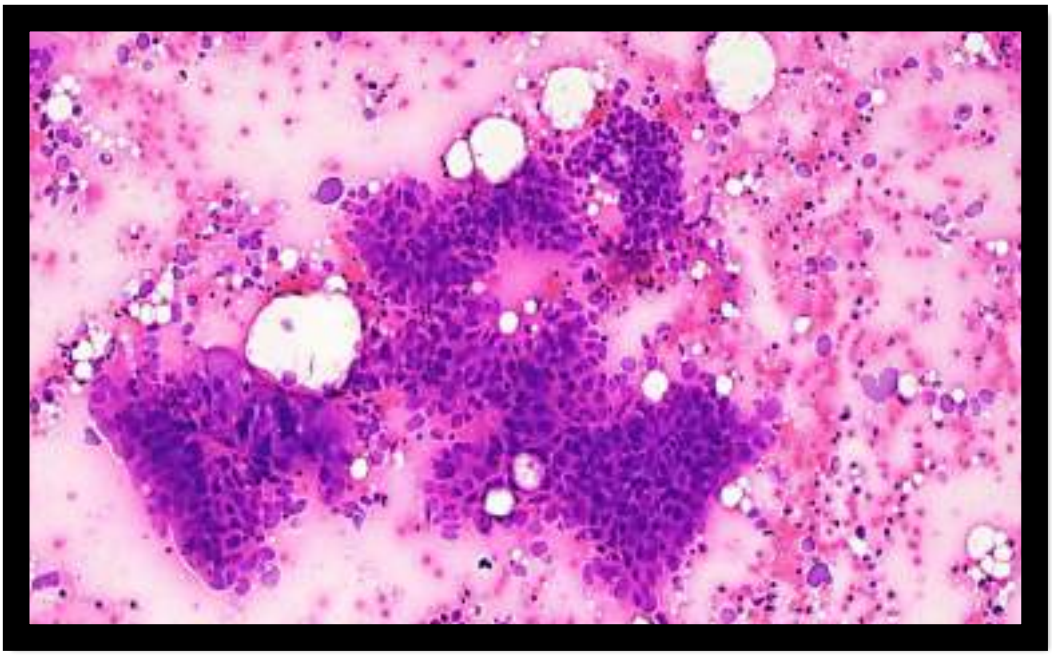


Picture No.26:Suspicious for malignancy, frozen section: Photomicrograph from eyelid margin showing crushing and streaking artefact leading to cell clustering giving false interpretation of malignancy. [H&E,100X]

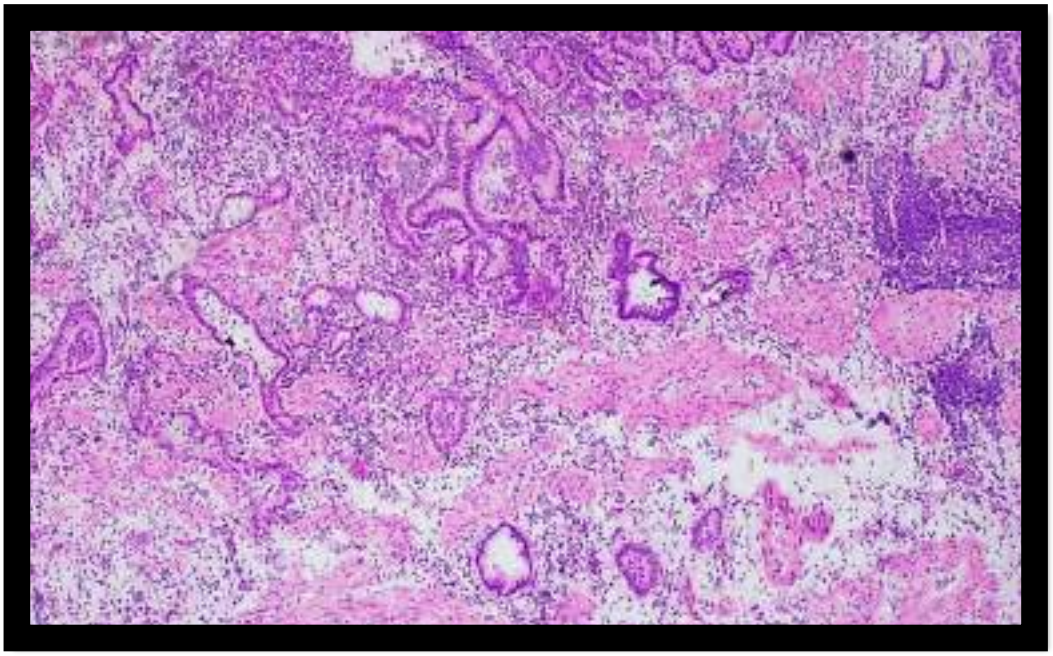


Picture No.27: Negative for malignancy, histopathology: Photomicrograph from eyelid margin showing normal epithelium with no evidence of malignancy. [H&E,100X]

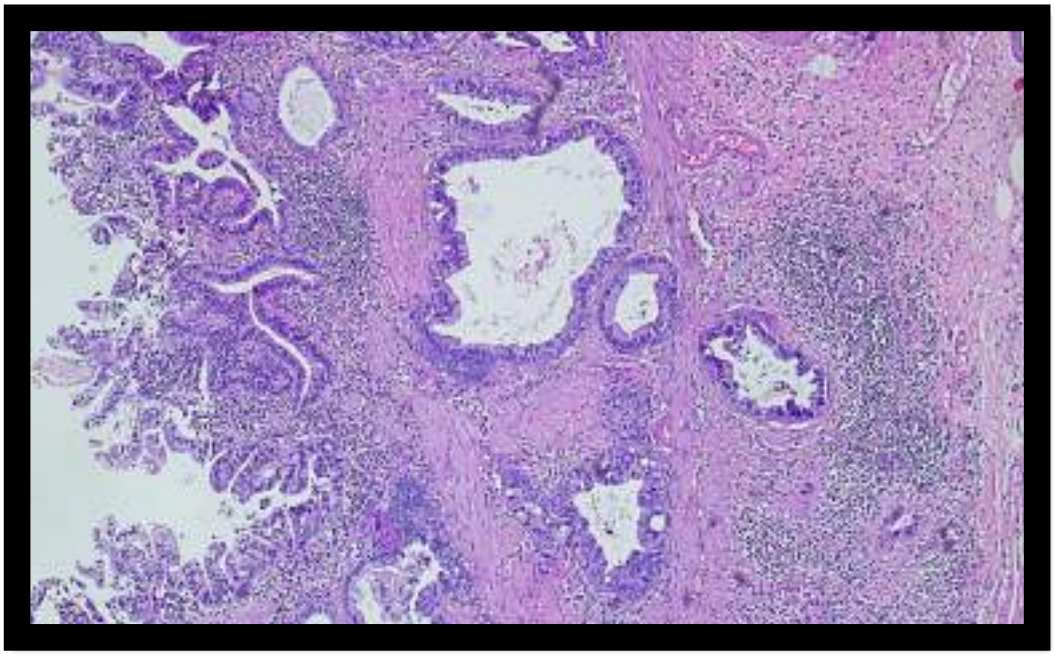
GALL BLADDER



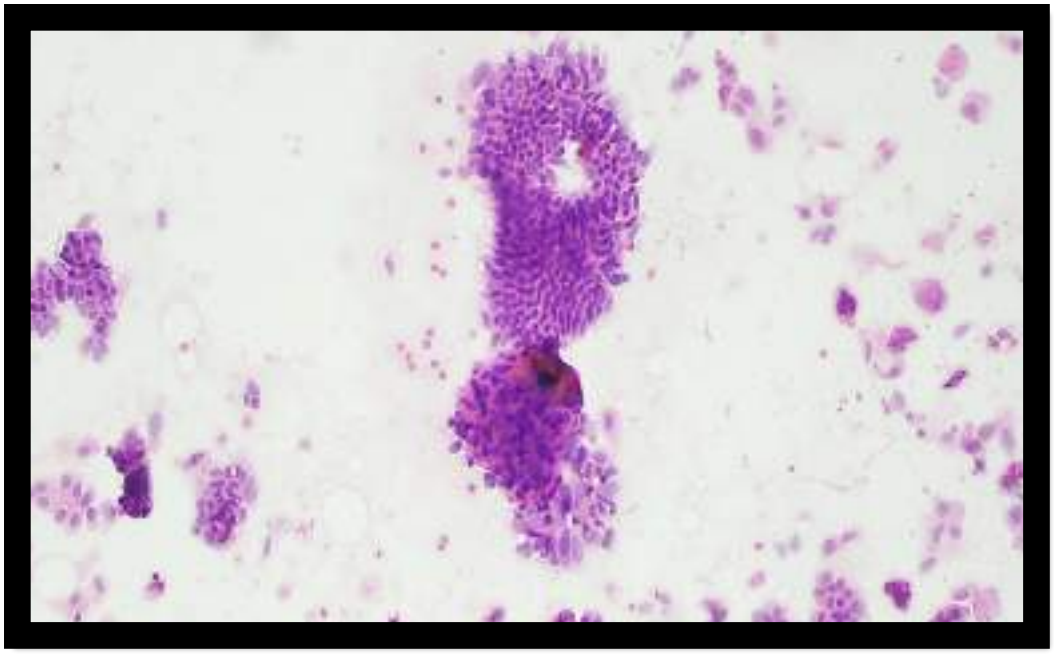
Picture No.28: Adenocarcinoma, imprint cytology: Photomicrograph from gall bladder shows tumor cells arranged in glands and papillae having hyperchromatic enlarged nuclei and scant amount of cytoplasm. [H&E, 100X]



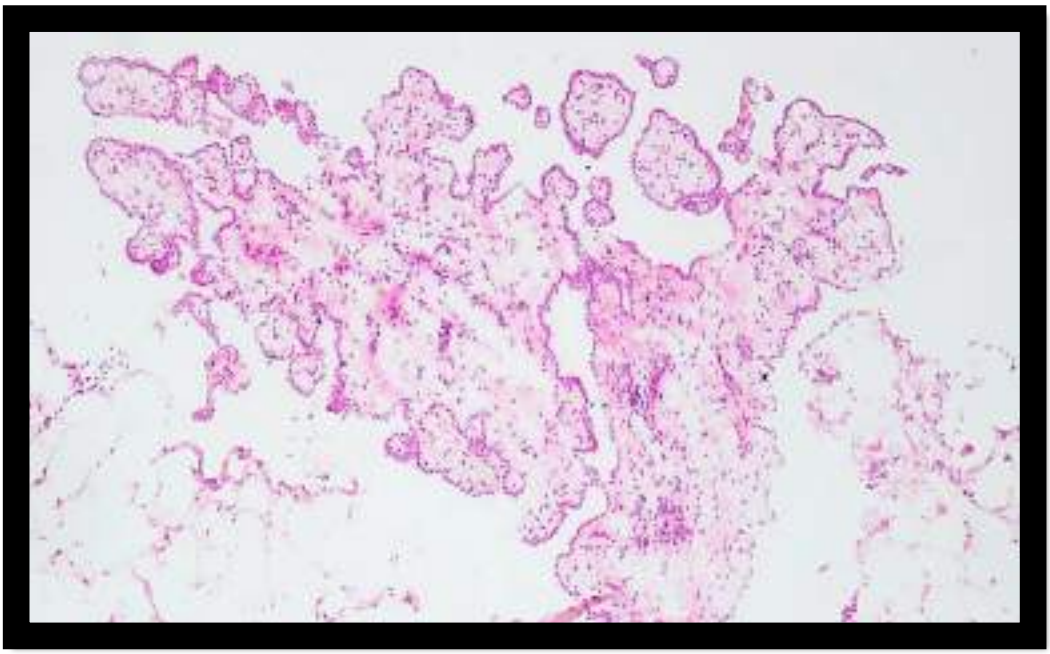
Picture No.29: Adenocarcinoma, frozen section: Photomicrograph from gall bladder showing neoplastic glands exhibiting nuclear hyperchromasia and pleomorphism. [H&E,100X]



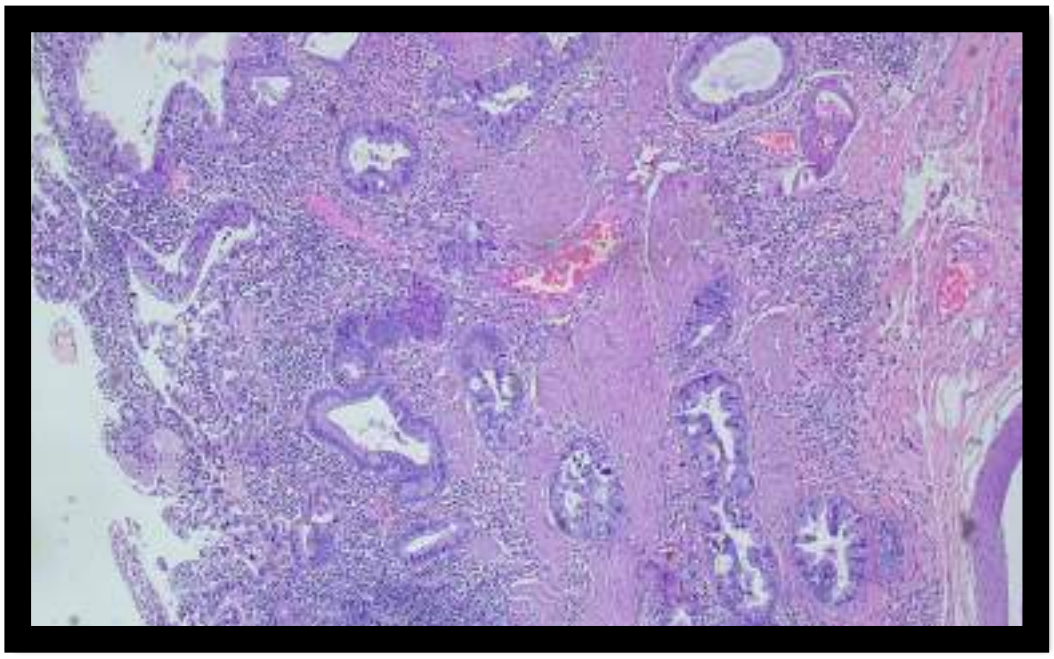
Picture No.30: Adenocarcinoma, histopathology: Photomicrograph from gall bladder showing neoplastic glands having hyperchromatic nuclei and scant amount of cytoplasm. [H&E, 100X]



Picture No.31: Adenocarcinoma, imprint cytology: Photomicrograph from gall bladder showing tumor cells forming glands having hyperchromatic pleomorphic nuclei and scant cytoplasm. [H&E,100X]

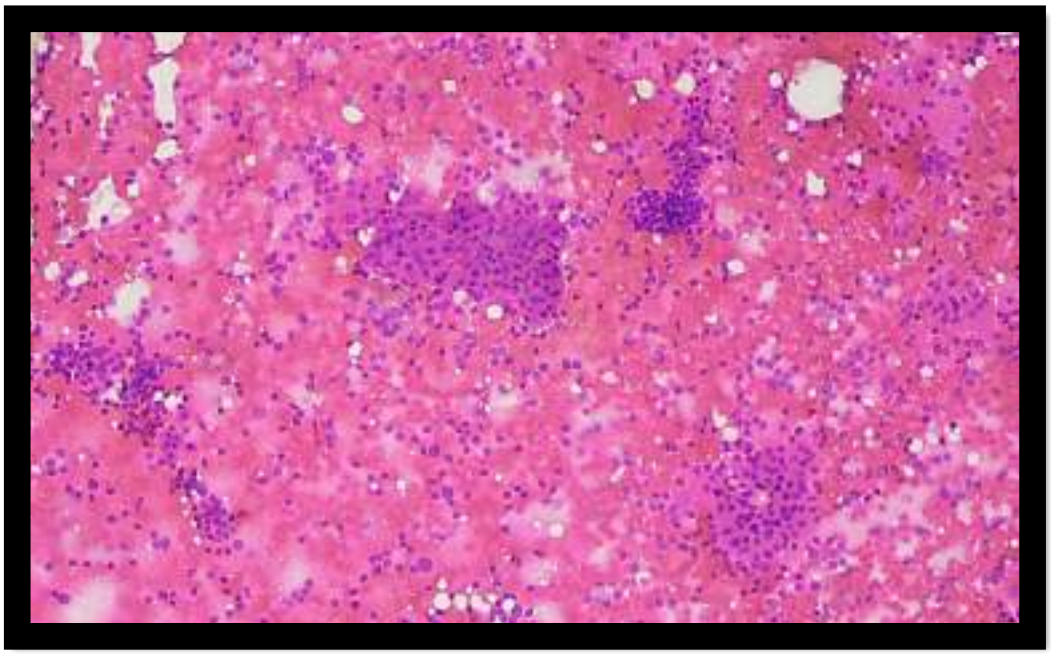


Picture No. 32: Negative for malignancy, frozen section: Photomicrograph from gall bladder showing mesothelial cell proliferation with no evidence of malignancy. [H&E, 100X]

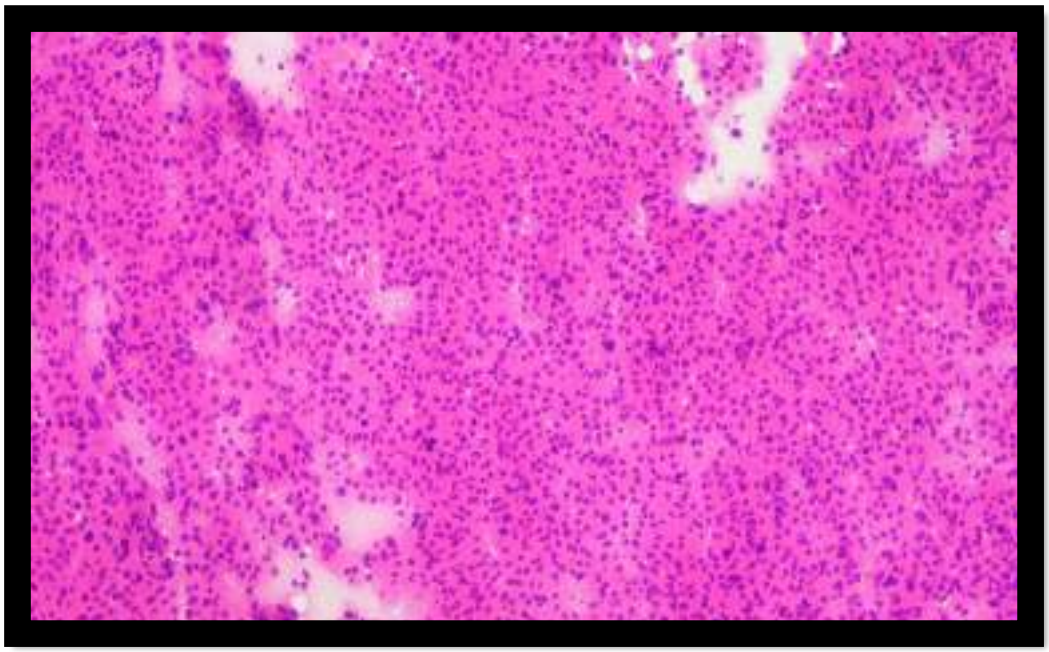


Picture No. 33: Adenocarcinoma, histopathology: Photomicrograph of gall bladder having presence of neoplastic glands in the wall. The tumor cells exhibit marked nuclear pleomorphism with moderate to scant amount of cytoplasm. [H&E, 100X]

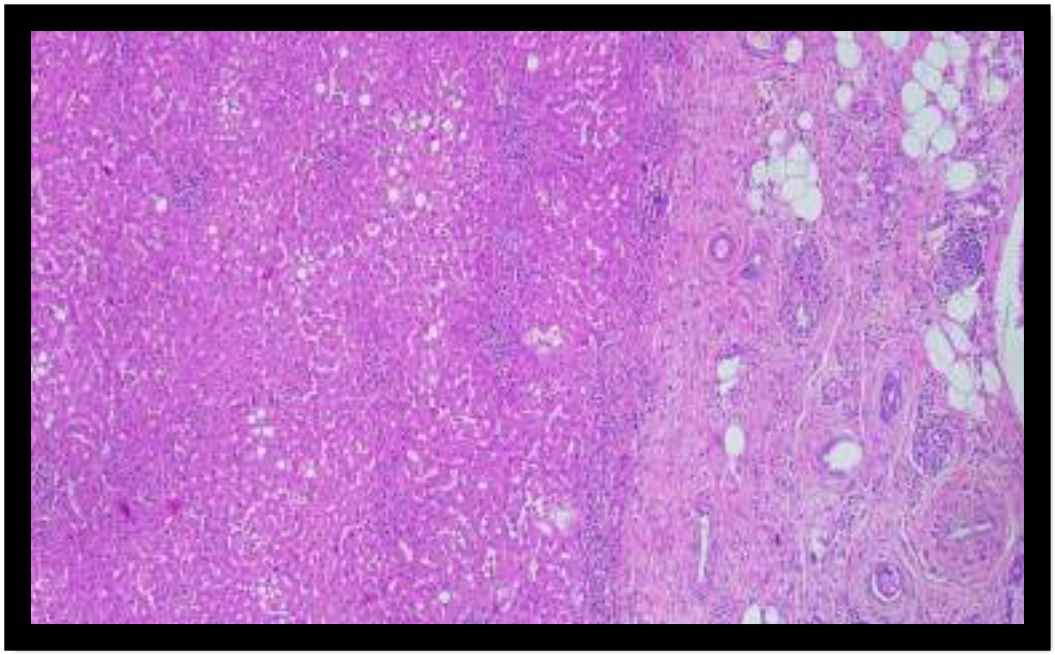
PARATHYROID GLAND



Picture No. 34: Parathyroid adenoma, imprint cytology: Photomicrograph from parathyroid gland showing clusters and singly scattered polygonal cells having round nuclei and abundant eosinophilic cytoplasm. [H&E,100X]

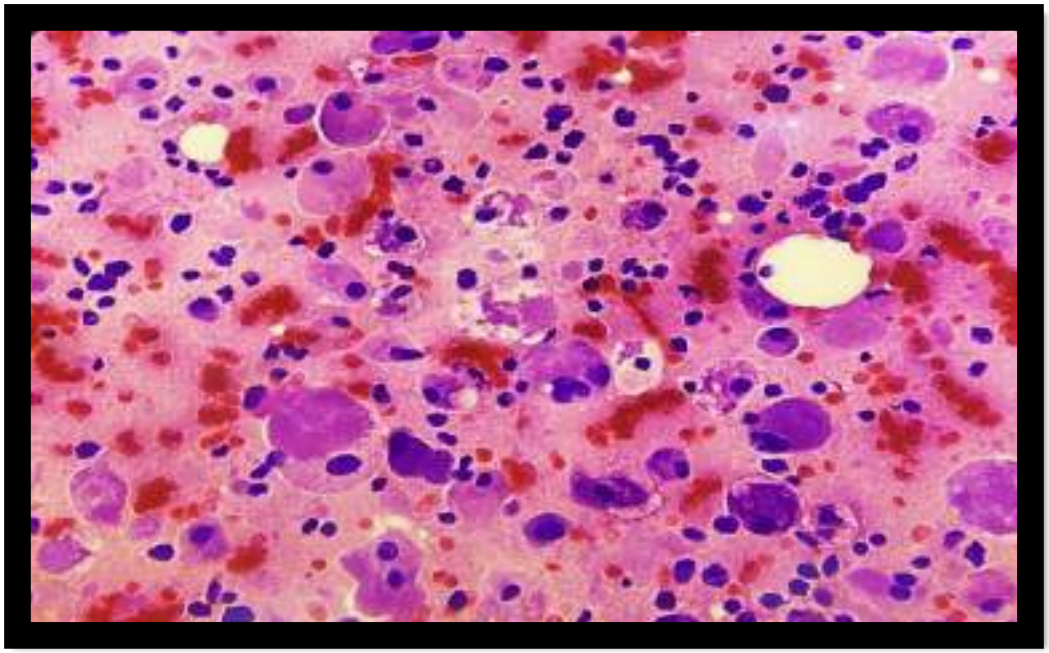


Picture No. 35: Parathyroid adenoma, frozen section: Photomicrograph from parathyroid gland showing sheets of polygonal cells with abundant eosinophilic cytoplasm. [H&E, 100X]

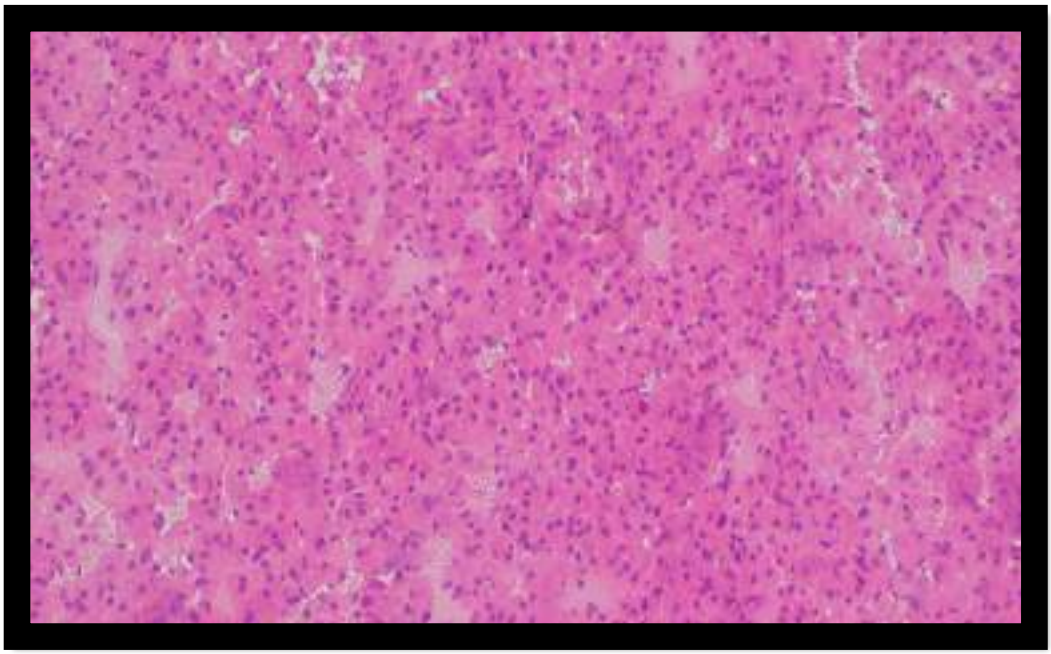


Picture No. 36: Parathyroid adenoma, histopathology: Photomicrograph showing a well circumscribed tumor surrounded by a fibrous capsule composed of round cells with granular eosinophilic cytoplasm. [H&E, 100X]

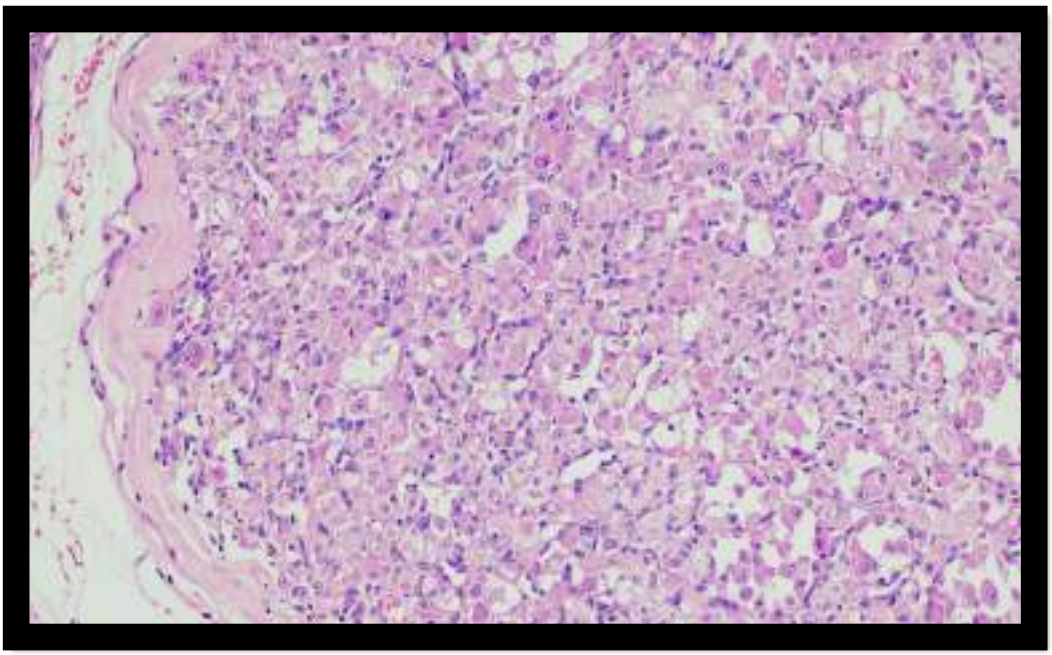
ALVEOLAR SOFT PART SARCOMA



Picture No. 37: Alveolar soft part sarcoma, imprint cytology: Photomicrograph from thigh mass having presence of scattered polygonal cells with round nuclei and abundant granular cytoplasm having cytoplasmic crystals. [H&E, 100X]



Picture No. 38: Alveolar soft part sarcoma, frozen section: Photomicrograph from thigh mass showing sheets of tumor cells, polygonal in shape showing central discohesion resulting in pseudo- alveolar like structure. [H&E, 100X]



Picture No. 39: Alveolar soft part sarcoma, histopathology: Photomicrograph from thigh mass shows tumour cells arranged in nests and alveolar growth pattern. The tumor cells are large rounded to polygonal have vesicular nuclei, prominent nucleoli and abundant amount of eosinophilic granular cytoplasm. [H&E,100X]

KEY TO MASTER CHART

TKR	Total Knee Replacement
AV	Arterio-Venous
NA	Not Applicable

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
1	1374453	48	Female	22-157	22-10754	11:50am	Uterine adenomyosis	SMALL	Endometrium	Primary diagnosis	Benign endometrial lesion
2	1316498	63	Female	22-158	22-10762, 10772	1:12pm	K/C/O carcinoma esophagus	Large	Margin	Resected margin status	Free of tumor
3	1376681	27	Female	22-159	22-10805, 22-10835	10:56am	Adnexal mass	Large	Left ovary	Primary diagnosis	Carcinoma
4	1381226	55	Male	22-160	22-10854	11:35am	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	Carcinoma
5	1381696	63	Male	22-161	22-11061	10:45am	Gall bladder carcinoma	SMALL	Gall bladder	Primary diagnosis	Carcinoma
6	1340841	58	Female	22-162	11261-22	12:58pm	Breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
7	1340841	58	Female	22-163	22-11262	12:58pm	Breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
8	1384755	64	Female	22-164	22-11512	11:09am	Nasal carcinoma	SMALL	Nose	Primary diagnosis	Positive for malignancy
9	1380398	71	Male	22-165	22-11637, 22-11635, 22-11636	11:38am	Bladder carcinoma	SMALL	Left ureteric margin	resected margin status	Free of tumor
10	1380398	71	Male	22-166	22-11637, 22-11635, 22-11636	11:38am	Bladder carcinoma	SMALL	Right ureteric margin	resected margin status	Free of tumor
11	1392235	27	Female	22-167	22-11680	11:00am	Mucinons cystadenoma	Large	Ovary	Primary diagnosis	Mucinous Neoplasm
12	1390741	57	Female	22-168	222-11689	11:00am	Benign cyst	SMALL	Scalp margin	resected margin status	Free of tumor
13	1157620	66	Male	22-169	22-5841	10:45am	Total knee replacement	SMALL	Right knee joint	Infection	No inflammatory cells.
14	1395323	50	Female	22-170	22-11898, 22-11901	1:00pm	Glioma	SMALL	Brain	Primary diagnosis	Tumor Present
15	1396573	36	Female	22-171	22-11994, 12030	1pm	Tubo-ovarian mass	Large	Left ovary	Primary diagnosis	Normal elements
16	1396970	46	Female	22-172	22-12089	10:32am	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	No evidence of malignancy
17	1389532	55	Female	22-173	22-12070	1:38pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
18	1389532	55	Female	22-174	22-12071	1:38pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
19	1389532	55	Female	22-175	22-12072	1:38pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
20	1395188	66	Female	22-176	22-12330, 12352	10:50am	Carcinoma thyroid	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
1	Benign endometrial polyp	Benign endometrial polyp	25 minutes	29 minutes	Yes,Hysterectomy with bilateral salpingoophorectomy	Concordant	Concordant
2	Free of tumor	Free of tumor	18 minutes	34 minutes	NA	Concordant	Concordant
3	Carcinoma	Endometroid carcinoma	19 minutes	29 minutes	Yes,Hysterectomy with bilateral salpingoophorectomy and pelvic lymph node dissection with omentectomy	Concordant	Concordant
4	Negative for malignancy,NOS	Adenocarcinomama gall bladder	33 minutes	40 minutes	NA	Concordant	Discordant
5	Intramucosal carcinoma	Adenocarcinoma	23 minutes	35 minutes	Yes,wedge reesection of liver with lymph node dissection	Concordant	Concordant
6	Reactive hyperplasia	Reactive hyperplasia	14 minutes	29 minutes	Yes,Breast conservation surgery	Concordant	Concordant
7	Reactive hyperplasia	Reactive hyperplasia	14 minutes	29 minutes	Yes,Breast conservation surgery	Concordant	Concordant
8	Basal cell carcinoma	Basal cell carcinoma	19 mimutes	41 minutes	NA	Concordant	Concordant
9	Free of tumor	Free of tumor	17 minutes	28 minutes	NA	Concordant	Concordant
10	Free of tumor	Free of tumor	17 minutes	28 minutes	NA	Concordant	Concordant
11	Mucinous neoplasm	Mucinous cystadenoma	35 minutes	41 minutes	NA	Concordant	Concordant
12	Free of tumor	Free of tumor	20 minutes	24 minutes	NA	Concordant	Concordant
13	Neutrophils < 2/hpf	Neutrophils <5/hpf	16 minutes	30 minutes	NA	Concordant	Concordant
14	High grade tumor	Glioblastoma	16 minutes	25 minutes	NA	Concordant	Concordant
15	Non neoplastic,NOS	Endometriotic cyst	35 minutes	45 minutes	NA	Discordant	Concordant
16	No evidence of malignancy	Adenomyomatosis gall bladder	28 minutes	35 minutes	NA	Concordant	Concordant
17	Reactive hyperplasia	Reactive hyperplasia	22 minutes	29 minutes	NA	Concordant	Concordant
18	Reactive hyperplasia	Reactive hyperplasia	22 minutes	29 minutes	NA	Concordant	Concordant
19	Reactive hyperplasia	Reactive hyperplasia	22 minutes	29 minutes	NA	Concordant	Concordant
20	Suspicious of malignancy	Reactive hyperplasia	30 minutes	55 minutes	Yes, Radical neck direction done	Concordant	Discordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
21	1401195	64	Female	22-177	22-12522, 22-12530	12:26pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
22	1406204	59	Female	22-178	22-12581, 22-12595	1:40pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
23	1406204	59	Female	22-179	22-12583, 22-12595	1:40pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
24	1406204	59	Female	22-180	22-12595	1:40pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
25	1408466	64	Female	22-181	22-12723, 22-12739	10:52am	Abdomino plevic mass	Large	Left ovary	Primary diagnosis	Mucinous neoplasm
26	1404629	71	Female	22-182	22-12902, 12889	1:50pm	Left breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
27	1406106	35	Female	22-183	22-13058	10:47am	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	No evidence of malignancy
28	1414430	70	Female	22-184	22-13098, 22-13111	11:18am	Left breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
29	933298	57	Female	22-185	22-13154, 22-13163, 22-1456	11:01am	Uterine carcinoma	SMALL	Endometrium	Primary diagnosis	Carcinoma
30	930731	71	Male	22-188	22-13162	11:45pm	Eyelid lesion	SMALL	Eyelid lesion	Primary diagnosis	Positive for malignancy
31	1415303	37	Male	22-189	22-13210	10:40am	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	Chronic cholecystitis
32	1418507	61	Female	22-190	22-13416	1:50pm	Right breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
33	1418507	61	Female	22-191	22-13417	1:50pm	Right breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
34	1419782	56	Male	22-192	22-13619	10:10am	Mandibular Carcinoma	SMALL	Mandible	Primary diagnosis	Positive for malignancy
35	1420763	65	Female	22-193	22-13717	9:36am	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	Positive for malignancy
36	1421200	60	Female	22-194	22-13710	1:00pm	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	Xanthogranulomatous cholecystits
37	1418834	63	Female	22-195	22-13863	2:12pm	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyorid adenoma
38	1424128	39	Female	22-196	22-13885	11:00am	Right ovarian cyst	Large	Right ovary	Primary diagnosis	Endometriosis

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
21	Reactive hyperplasia	Reactive hyperplasia	24 minutes	34 minutes	NA	Concordant	Concordant
22	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	18 minutes	30 minutes	Yes, Right Level 3 lymph node dissection	Concordant	Concordant
23	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	18 minutes	30 minutes	Yes, Right Level 3 lymph node dissection	Concordant	Concordant
24	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	18 minutes	30 minutes	Yes, Right Level 3 lymph node dissection	Concordant	Concordant
25	Normal elements	Mucinous Adenocarcinoma	30 minutes	32 minutes	Yes,Hysterectomy with Bilatelaral pelvic lymph node dissection	Concordant	Discordant
26	Reactive hyperplasia	Reactive hyperplasia	15 minutes	27 minutes	NA	Concordant	Concordant
27	Inflammatory pathology	Acute on chronic cholecystitis	17 minutes	27 minutes	NA	Concordant	Concordant
28	Reactive hyperplasia	Reactive hyperplasia	22 minutes	32 minutes	NA	Concordant	Concordant
29	Endometroid carcinoma	Carcinosarcoma endometrium	35 minutes	45 minutes	Yes,Bilateral pelvic lymph node and para-aortic lymph node dissection and omentectomy	Concordant	Concordant
30	Epithelial neoplasm	1.Mucinous eccrine carcinoma 2.Endocrine mucin secreting sweat gland carcinoma	14 minutes	25 minutes	NA	Concordant	Concordant
31	Chronic cholecystitis	Chronic cholecystitis	46 minutes	46 minutes	NA	Concordant	Concordant
32	Reactive hyperplasia	Reactive hyperplasia	15 minutes	30 minutes	NA	Concordant	Concordant
33	Reactive hyperplasia	Reactive hyperplasia	15 minutes	30 minutes	NA	Concordant	Concordant
34	Malignant epithelial tumor	Ameloblastic carcinoma	22 minutes	35 minutes	Yes,Right and Left neck dissection	Concordant	Concordant
35	Negative for malignancy,Mesothelial cell proliferation	Adenocarcinomama gall bladder	29 minutes	39 minutes	Wedge resection of liver,periportal and lymph nodes around hepatoduodenal ligament resected	Concordant	Discordant
36	Xanthogranulomatous cholecystits	Xanthogranulomatous cholecystits	12 minutes	28 minutes	NA	Concordant	Concordant
37	Parathyorid adenoma	Parathyorid adenoma	48 minutes	77 minutes	NA	Concordant	Concordant
38	Endometriosis	Endometriotic cyst	18 minutes	45 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
39	1422593	44	Female	22-197	22-13886	11:34am	Adnexal mass	Large	Left ovary	Primary diagnosis	Endometriosis
40	1423672	55	Female	22-198	22-13891	1:46pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
41	1423672	55	Female	22-199	22-13892	1:46pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
42	1427159	60	Male	22-200	22-13995	11:48am	Mass lesion on upper eyelid	SMALL	Temporal margin	resected margin status	Negative for tumor
43	1427159	60	Male	22-201	22-13995	11:48am	Mass lesion on upper eyelid	SMALL	Superior margin	resected margin status	Negative for tumor
44	1427159	60	Male	22-202	22-13995	11:48am	Mass lesion on upper eyelid	SMALL	Nasal margin	resected margin status	Negative for tumor
45	1427100	48	Female	22-203	22-14113	11:30am	Endometrial hyperplasia	SMALL	Endometrium	Primary diagnosis	Normal elements
46	1428381	59	Female	22-204	22-14098	2:00pm	Invasive breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
47	1428381	59	Female	22-205	22-14099	2:00pm	Invasive breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
48	1428381	59	Female	22-206	22-14100	2:00pm	Invasive breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
49	1427972	56	Male	22-207	22-14101	2:35pm	Gall bladder carcinoma	SMALL	Gall bladder	Primary diagnosis	Adenocarcinoma
50	1427023	20	Female	22-208	22-14136	3:15pm	Endometriosis	SMALL	Right ovary	Primary diagnosis	Normal elements
51	1427023	20	Female	22-209	22-14105	4:00pm	Endometriosis	SMALL	Right ovary	Primary diagnosis	Endometriosis
52	1353566	60	Female	122-210	22-14135	10:46am	Post Total Knee Replacement infection	SMALL	Knee joint	Infection	No prominence of neutrophils
53	1428834	62	Male	22-211	22-14180	10:55am	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyorid adenoma
54	1323157	49	Female	22-213	22-213 Left over	2:00pm	Lower eyelid lesion	SMALL	Eyelid lesion	Primary diagnosis	No evidence of malignancy
55	1423624	50	Female	22-214	22-14345	11:10am	Cystic lesion	Large	Left ovary	Primary diagnosis	Mucinous neoplasm
56	1428352	68	Female	22-215	22-14347	1:03pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
57	1428352	68	Female	22-216	22-14348	1:03pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
58	1430959	29	Female	22-217	22-14400	2:03pm	Ovarian abscess	SMALL	Left ovary	Primary diagnosis	Normal elements

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
39	Endometriosis	Endometriotic cyst	14 minutes	28 minutes	NA	Concordant	Concordant
40	Reactive hyperplasia	Reactive hyperplasia	14 minutes	34 minutes	NA	Concordant	Concordant
41	Reactive hyperplasia	Reactive hyperplasia	14 minutes	34 minutes	NA	Concordant	Concordant
42	Negative for tumor	Negative for tumor	12 minutes	52 minutes	NA	Concordant	Concordant
43	Negative for tumor	Negative for tumor	12 minutes	52 minutes	NA	Concordant	Concordant
44	Negative for tumor	Negative for tumor	12 minutes	52 minutes	NA	Concordant	Concordant
45	Normal elements	Normal elements	18 minutes	29 minutes	Yes,Hysterectomy with Bilateral salpingo-oophorectomy done	Concordant	Concordant
46	Reactive hyperplasia	Reactive hyperlasia	17 minutes	42 minutes	NA	Concordant	Concordant
47	Reactive hyperplasia	Reactive hyperlasia	17 minutes	42 minutes	NA	Concordant	Concordant
48	Reactive hyperplasia	Reactive hyperlasia	17 minutes	42 minutes	NA	Concordant	Concordant
49	Adenocarcinoma	Adenocarcinoma	15 minutes	19 minutes	Yes, Clearance of lymphnodes along HDL, Retroportal, CHA	Concordant	Concordant
50	Endometriosis	Endometriotic cyst	15 minutes	25 minutes	NA	Discordant	Concordant
51	Endometriosis	Endometriotic cyst	15 minutes	18 minutes	NA	Concordant	Concordant
52	Neutrophils <5/hpf	Neutrophils <5/hpf	15 minutes	29 minutes	NA	Concordant	Concordant
53	Parathyroid adenoma	Parathyorid adenoma	18 minutes	41 minutes	NA	Concordant	Concordant
54	No evidence of malignancy	Candidiasis	15 minutes	26 minutes	NA	Concordant	Concordant
55	Mucinous neoplasm	Mucinous borderline tumor	26 minutes	35 minutes	Yes, Hysterectomy with Bilateral salpingo-oophorectomy and omentectomy	Concordant	Concordant
56	Reactive hyperplasia	Reactive hyperplasia	13 minutes	15 minutes	NA	Concordant	Concordant
57	Reactive hyperplasia	Reactive hyperplasia	13 minutes	15 minutes	NA	Concordant	Concordant
58	Normal elements	Normal elements	27 minutes	42 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
59	1430959	29	Female	22-218	22-14401	2:03pm	Ovarian abscess	SMALL	Right ovary	Primary diagnosis	Normal elements
60	1434176	63	Female	22-221	22-14629	4:10pm	Gall bladder carcinoma	Large	Gall bladder	Primary diagnosis	Xanthogranulomatous cholecystitis
61	1433964	68	Female	22-222	22-14672	12 noon	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
62	1433964	68	Female	22-223	22-14673	12 noon	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
63	1433964	68	Female	22-224	22-14674	12 noon	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
64	1435699	26	Female	22-225	22-14764	2:58pm	Fibroids	Large	Fibroid	Primary diagnosis	Leiomyoma
65	1435699	26	Female	22-226	22-14764	2:51pm	Ovarian cyst	SMALL	Right ovary	Primary diagnosis	Normal elements
66	4348	47	Female	22-227	22-14893	12:50pm	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid adenoma
67	1435367	38	Female	22-228	22-14765, 22-14797	3:02pm	Carcinoma ovary	SMALL	Left ovary	Primary diagnosis	Non neoplastic,NOS
68	1434771	43	Female	22-229	22-14862	11:30am	Endometrial hyperplasia	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
69	1436926	42	Female	22-230	22-14887	11:40am	Ovarian mass	Large	Right ovary	Primary diagnosis	Spindle cell neoplasm
70	1357562	71	Female	22-231	22-14940	12:30pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
71	1357562	71	Female	22-232	22-14941	12:30pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
72	1438924	52	Female	Fs-23-01	23-51	1:35pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
73	1438924	52	Female	FS-23-02	23-52	1:35pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
74	107512	41	Female	Fs-23-03	23-114	3:06pm	Not available	SMALL	Endometrial curretings	Primary diagnosis	Deferred
75	1441653	66	Female	23-04	23-191	12:44pm	Right breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
76	1441653	66	Female	23-05	23-192	12:44pm	Right breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
77	1441653	66	Female	23-06	23-193	12:44pm	Right breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
59	Normal elements	Normal elements	27 minutes	42 minutes	NA	Concordant	Concordant
60	Xanthogranulomatous cholecystitis	Xanthogranulomatous cholecystitis	20 minutes	33 minutes	NA	Concordant	Concordant
61	Reactive hyperplasia	Reactive hyperplasia	30 minutes	42 minutes	NA	Concordant	Concordant
62	Reactive hyperplasia	Reactive hyperplasia	30 minutes	42 minutes	NA	Concordant	Concordant
63	Reactive hyperplasia	Reactive hyperplasia	30 minutes	42 minutes	NA	Concordant	Concordant
64	Leiomyoma with hyaline change	Leiomyoma with hyaline change and red degeneration	12 minutes	23 minutes	NA	Concordant	Concordant
65	Normal elements	Normal elements	21 minutes	41 minutes	NA	Concordant	Concordant
66	Parathyroid adenoma	Parathyroid adenoma	25 minutes	32 minutes	NA	Concordant	Concordant
67	Non neoplastic,NOS	Simple cyst	17 minutes	30 minutes	NA	Concordant	Concordant
68	Normal elements	Normal elements	30 minutes	48 minutes	NA	Concordant	Concordant
69	Stromal tumor	Sex cord stromal tumor	20 minutes	48 minutes	NA	Concordant	Concordant
70	Reactive hyperplasia	Reactive hyperplasia	40 minutes	53 minutes	NA	Concordant	Concordant
71	Reactive hyperplasia	Reactive hyperplasia	40 minutes	53 minutes	NA	Concordant	Concordant
72	Reactive hyperplasia	Reactive hyperplasia	13 minutes	28 minutes	NA	Concordant	Concordant
73	Reactive hyperplasia	Reactive hyperplasia	13 minutes	28 minutes	NA	Concordant	Concordant
74	Normal elements	Normal elements	10 minutes	24 minutes	NA	Discordant	Concordant
75	Reactive hyperplasia	Reactive hyperplasia	29 minutes	44 minutes	NA	Concordant	Concordant
76	Reactive hyperplasia	Reactive hyperplasia	29 minutes	44 minutes	NA	Concordant	Concordant
77	Reactive hyperplasia	Reactive hyperplasia	29 minutes	44 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
78	1442818	42	Female	23-07	23-226	12:10pm	Fibroid	Large	Fibroid	Primary diagnosis	Spindle cell neoplasm
79	1437273	54	Female	23-08	23-309	12:30pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
80	1437273	54	Female	23-09	23-310	12:30pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
81	1437273	54	Female	23-10	23-311	12:30pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
82	1437273	54	Female	FS-23-11	23-314	12:30pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
83	1442359	65	Female	FS-23-12	23-377	11:54am	Left adnexal cyst	Large	Left ovary	Primary diagnosis	Mucinous neoplasm
84	1446215	27	Female	23-13	23-563	2:01pm	Adnexal mass	Large	Left ovary	Primary diagnosis	Benign surface epithelial tumor
85	1447026	37	Female	FS-23-14	23-586	12:30pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
86	1447026	37	Female	FS-23-15	23-587	12:30pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
87	1447026	37	Female	FS-23-16	23-588	12:30pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
88	1442632	67	Male	Fs-23-17	23-628	10:41am	Periampullary carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
89	1448931	42	Female	23-18	23-751	2:10pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
90	1450474	52	Female	23-19	23-788	12:30pm	Left breast carcinoma	Large	Sentinel lymph node	Metastasis	Reactive hyperplasia
91	965282	45	Female	Fs-20-23	23-941	11:13am	Malignant cyst	Large	Anterior Abdominal Cyst wall	Primary diagnosis	No evidence of malignancy
92	965282	45	Female	FS-21-23	23-942	11:13am	Malignant cyst	SMALL	Omental nodule	Metastasis	Inflammatory pathology
93	965282	45	Female	FS-22-23	23-942	11:13am	Bowel nodule Malignant	SMALL	Bowel nodule	Metastasis	No evidence of malignancy
94	1456482	59	Female	FS23-23	23-1133	10:20am	Suspicious for malignancy	SMALL	Left cervical lymph node	Primary diagnosis	Suspicuous of malignancy
95	1458819	65	Female	23-24	23-1265	10:39am	Right ovarian mass	Large	Right ovary	Primary diagnosis	Mucinous neoplasm
96	1460990	40	Female	23-FS-25	23-1407	10:30am	Left Breast Carcinoma	SMALL	Left breast lump	Primary diagnosis	Positive for malignancy

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
78	Mesenchymal tumor	Leiomyoma with hyaline necrosis and red degeneration	20 minutes	41 minutes	NA	Concordant	Concordant
79	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	46 minutes	62 minutes	Yes Level 3 lymph nodes dissection	Discordant	Concordant
80	Reactive hyperplasia	Reactive hyperplasia	46 minutes	62 minutes	Yes, Level 3 lymph nodes dissection	Concordant	Concordant
81	Reactive hyperplasia	Reactive hyperplasia	46 minutes	62 minutes	Yes, Level 3 lymph nodes dissection	Concordant	Concordant
82	Reactive hyperplasia	Reactive hyperplasia	46 minutes	62 minutes	Yes, Level 3 lymph nodes dissection	Concordant	Concordant
83	Mucinous neoplasm	Mucinous cystadenona	16 minutes	30 minutes	NA	Concordant	Concordant
84	Benign surface epithelial tumor	Serous cystadenofibroma	13 minutes	23 minutes	NA	Concordant	Concordant
85	Reactive hyperplasia	Reactive hyperplasia	16 minutes	35 minutes	NA	Concordant	Concordant
86	Reactive hyperplasia	Reactive hyperplasia	16 minutes	35 minutes	NA	Concordant	Concordant
87	Reactive hyperplasia	Reactive hyperplasia	16 minutes	35 minutes	NA	Concordant	Concordant
88	Reactive hyperplasia	Reactive hyperplasia	17 minutes	24 minutes	NA	Concordant	Concordant
89	Reactive hyperplasia	Reactive hyperplasia	17 minutes	31 minutes	NA	Concordant	Concordant
90	Reactive hyperplasia	Reactive hyperplasia	15 minutes	25 minutes	NA	Concordant	Concordant
91	No evidence of malignancy	No evidence of malignancy	18 minutes	54 minutes	Yes,Left pelvic lymph node dissection	Concordant	Concordant
92	Inflammatory pathology	No evidence of malignancy	18 minutes	54 minutes	Yes,Left pelvic lymph node dissection	Concordant	Concordant
93	No evidence of malignancy	No evidence of malignancy	18 minutes	54 minutes	Yes,Left pelvic lymph node dissection	Concordant	Concordant
94	Malignant round cell tumor	Metastatic deposits of neuroendocrine carcinoma,small cell type	20 minutes	25 minutes	NA	Concordant	Concordant
95	Mucinous neoplasm	Mucinous cystadenoma	21 minutes	33 minutes	NA	Concordant	Concordant
96	Invasive Duct carcinoma NOS	Invasive Duct carcinoma NOS	38 minutes	45 minutes	Yes, Lumpectomy with axillary & level 3 lymph node dissection	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
97	1460990	40	Female	23-FS-26	23-1418	10:30am	Left Breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
98	1460990	40	Female	23-FS-27	23-1417	10:30am	Left Breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Suspicious for malignancy
99	1359189	70	Female	23-FS-28	23-1675	11:40am	Pelvic mass	Large	Ovary	Primary diagnosis	Benign surface epithelial tumor
100	1359189	70	Female	FS-23-29	23-1678	12:40pm	Pelvic mass	Large	Omental nodule	Metastasis	Negative for malignancy
101	1272588	44	Male	FS-23-30	23-1762	10:35pm	Distal descending colon growth	SMALL	Bowel nodule	Metastasis	Positive for malignancy
102	1447308	58	Female	23-FS-31	23-1767	2:40pm	Pain abdomen, uterine mass	Large	Endometrium	Primary diagnosis	Malignant neoplasm
103	1460594	45	Female	23-FS-32	23-1862	11:58am	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid Adenoma
104	1428008	41	Female	23-FS-33	23-1884	11:48am	Thickening at wall of stomach	Large	Margin	resected margin status	Free of tumor
105	1465194	35	Female	23-FS-34	23-1864	12:52pm	Left Breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
106	1465194	35	Female	23-FS-35	23-1865	12:52pm	Left Breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
107	1465194	35	Female	23-FS-36	23-1866	12:52pm	Left Breast Carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
108	1467729	55	Female	23-FS-37	23-2015	11:26am	Thickened endometrium	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
109	729317	44	Male	FS-23-38	23-167	2:32pm	Lymphadenopathy	SMALL	Right cervical lymph node	Infection	Inflammatory pathology,chronic.
110	1455307	51	Male	FS-23-39	23-2311, 23-2349	12:53pm	Chest pain	SMALL	Lung tissue	Infection	Inflammatory pathology
111	1472680	43	Female	23-FS-40	23-2312	10:26am	Endometrial hyperplasia	SMALL	Endometrium	Primary diagnosis	Normal elements
112	1309233	62	Male	FS-23-41	23-2300	10:50am	Carcinoma tongue	SMALL	Tongue	Primary diagnosis	Negative for malignancy
113	1476308	39	Female	FS-23-42	23-2524	12:35pm	Fibroid	Large	Fibroid	Primary diagnosis	Spindle cell lesion
114	1476308	39	Female	FS-23-43	23-2530	12:45pm	Right ovarian cyst	SMALL	Right ovary	Primary diagnosis	Normal elements
115	1478231	50	Female	23-FS-44	23-2614	12:45pm	Fibroid uterus	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
116	1478887	68	Female	23-FS-45	23-2644	10:36am	Carcinoma ovary	Large	Left ovary	Primary diagnosis	Carcinoma

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
97	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	38 minutes	45 minutes	Yes, Lumpectomy with axillary & level 3 lymph node dissection	Concordant	Concordant
98	Reactive hyperplasia	Reactive hyperplasia	38 minutes	45 minutes	Yes, Lumpectomy with axillary & level 3 lymph node dissection	Discordant	Concordant
99	Benign surface epithelial tumor	Serous cystadenofibroma	20 minutes	46 minutes	NA	Concordant	Concordant
100	Negative for malignancy	Negative for malignancy	10 minutes	24 minutes	NA	Concordant	Concordant
101	Positive for malignancy	Positive for malignancy	15 minutes	29 minutes	Yes, Total colectomy done	Concordant	Concordant
102	Malignant neoplasm	Leiomyosarcoma	12 minutes	26 minutes	Yes,pelvic lymph node dissection	Concordant	Concordant
103	Parathyroid Adenoma	Parathyroid Adenoma	17 minutes	39 minutes	NA	Concordant	Concordant
104	Free of tumor	Free of tumor	12 minutes	27 minutes	NA	Concordant	Concordant
105	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	18 minutes	29 minutes	Yes, Left breast conservative surgery with Level III lymph node dissection	Concordant	Concordant
106	Reactive hyperplasia	Reactive hyperplasia	18 minutes	29 minutes	Yes, Left breast conservative surgery with Level III lymph node dissection	Concordant	Concordant
107	Reactive hyperplasia	Reactive hyperplasia	18 minutes	29 minutes	Yes, Left breast conservative surgery with Level III lymph node dissection	Concordant	Concordant
108	Normal elements	Normal elements	34 minutes	45 minutes	NA	Concordant	Concordant
109	Granulomatous inflammation	Granulomatous inflammation	20 minutes	28 minutes	NA	Concordant	Concordant
110	Inflammatory pathology	Inflammatory pathology	19 minutes	31 minutes	NA	Concordant	Concordant
111	Normal elements	Normal elements	34 minutes	46 minutes	NA	Concordant	Concordant
112	Negative for malignancy	Negative for malignancy	22 minutes	31 minutes	NA	Concordant	Concordant
113	Leiomyoma	Leiomyoma	31 minutes	40 minutes	NA	Concordant	Concordant
114	Normal elements	Normal elements	15 minutes	23 minutes	NA	Concordant	Concordant
115	Normal elements	Normal elements	28 minutes	28 minutes	NA	Concordant	Concordant
116	Borderline surface epithelial tumor	Endometroid carcinoma	24 minutes	32 minutes	Yes, B/l pelvic lymph node, para-aortic lymph node dissection and omentectomy	Concordant	Discordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
117	1474678	37	Female	23-FS-46	23-2694	12:09pm	Carcinoma cervix	SMALL	Cervix	Primary diagnosis	No specific pathology
118	1473071	72	Female	FS-23-47	23-2702	2:02pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
119	1473071	72	Female	23-FS-48	23-2703	2:02pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic Carcinomatous deposits
120	1474083	49	Female	23-FS-49	23-FS-49	10:00am	Eyelid mass	SMALL	Lateral margin	resected margin status	Suspicious for malignancy
121	1474083	49	Female	23-FS-50	23-FS-50	10:00am	Eyelid mass	SMALL	Medial margin	resected margin status	Free of tumour
122	1474083	49	Female	23-FS-51	23-FS-51	10:00am	Eyelid mass	SMALL	Superior margin	resected margin status	Suspicious for malignancy
123	1477616	30	Female	FS-23-52	23-2817	10:28am	Malignant nodule	SMALL	Liver	Metastasis	No evidence of malignancy
124	1359922	41	Female	23-FS-53	23-2757	10:31am	Adnexal mass	Large	Right ovary	Primary diagnosis	Endometriosis
125	1481461	56	Female	23-FS-54	FS-23-54	10:40am	Carcinoma cervix	SMALL	Cervix	Primary diagnosis	Squamous cell carcinoma
126	1479682	50	Female	FS-23-55	23-2864	10:40am	Carcinoma tongue	SMALL	Tongue	Primary diagnosis	Squamous cell carcinoma
127	1480330	33	Male	FS-23-56	FS-23-56	2:15pm	Squamous cell carcinoma	SMALL	Gingivo buccal sulcus	Primary diagnosis	Squamous cell carcinoma
128	1453112	70	Female	FS-23-57	23-2965	1:32pm	Carcinoma gall bladder	Large	Gall bladder	Primary diagnosis	Carcinoma
129	522863	50	Female	FS-23-58	23-2956	10:14am	Not available	SMALL	Endometrial curretings	Primary diagnosis	Deferred
130	1477599	55	Female	FS-23-59	23-3030	12:25pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
131	1477599	55	Female	FS-23-60	23-3031	12:25pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
132	1482834	74	Male	FS-23-61	FS-23-61	1:20pm	Biliary fistula	SMALL	Fistula	Primary diagnosis	Deferred
133	1484303	50	Female	FS-23-62	23-3143	1:32pm	Right adnexal mass	Large	Right ovary	Primary diagnosis	Papillary neoplasm
134	1473812	59	Female	FS-23-63	23-3200	12:16pm	Adnexal mass	SMALL	Left ovary	Primary diagnosis	Spindle cell neoplasm
135	1392365	67	Male	FS-23-64	23-3203	1:06pm	Parathyroid Adenoma	SMALL	Parathyorid gland	Primary diagnosis	Parathyroid Adenoma

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
117	Chronic cervicitis	Chronic cervicitis	21 minutes	31 minutes	NA	Concordant	Concordant
118	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	16 minutes	32 minutes	Yes,Right mastectomy and Level III lymph node dissection	Concordant	Concordant
119	Metastatic Carcinomatous deposits	Metastatic Carcinomatous deposits	16 minutes	32 minutes	Yes,Right mastectomy and Level III lymph node dissection	Concordant	Concordant
120	Suspicious for malignancy	Free of tumour	30 minutes	42 minutes	Yes, revised margins taken	Discordant	Discordant
121	Free of tumour	Free of tumour	30 minutes	42 minutes	Yes, revised margins taken	Concordant	Concordant
122	Suspicious for malignancy	Free of tumour	30 minutes	42 minutes	Yes, revised margins taken	Discordant	Discordant
123	No evidence of malignancy	No evidence of malignancy	18 minutes	40 minutes	NA	Concordant	Concordant
124	Endometriosis	Endometriosis	41 minutes	57 minutes	NA	Concordant	Concordant
125	Squamous cell carcinoma	Squamous cell carcinoma	20 minutes	44 minutes	NA	Concordant	Concordant
126	Squamous cell carcinoma	Squamous cell carcinoma	20 minutes	43 minutes	Yes, anterior glossectomy with level Ia to V lymph nodes dissection	Concordant	Concordant
127	Squamous cell carcinoma	Squamous cell carcinoma	16 minutes	25 minutes	Yes, Right hemimandibulectomy with level 1a, 1b, 2b, 2-3 lymph node dissection	Concordant	Concordant
128	Adeno carcinoma	Adeno carcinoma	12 minutes	23 minutes	Yes, wedge resection of liver with HDL lymph nodes and RP lymph node dissection	Concordant	Concordant
129	Normal elements	Normal elements	11 minutes	27 minutes	Yes,Hysterectomy with bilateral salpingo-oophorectomy	Discordant	Concordant
130	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	23 minutes	35 minutes	Left mastectomy with axillary lymph node dissection	Concordant	Concordant
131	Reactive hyperplasia	Reactive hyperplasia	23 minutes	35 minutes	Left mastectomy with axillary lymph node dissection	Concordant	Concordant
132	Deferred	No evidence of malignancy	16 minutes	29 minutes	NA	Discordant	Discordant
133	Borderline serous tumor	Adenocarcinoma,possibly Serous	14 minutes	16 minutes	Yes,Total hysterectomy with bilateral salingo-oophorectomy and Bilateral lymph node dissection	Concordant	Discordant
134	Spindle cell neoplasm- sex cord stromal tumor	Thecoma	16 minutes	22 minutes	Yes, Total abdominal hysterechomy with B/L fallopian tube & right ovary removal	Concordant	Concordant
135	Parathyroid adenoma	Parathyroid adenoma	20 minutes	34 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
136	1486229	38	Female	23-FS-65	23-3304	1:40pm	Right Carcinoma breast	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
137	1486229	38	Female	23-FS-66	23-3305	1:40pm	Right Carcinoma breast	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
138	1486229	38	Female	23-FS-67	23-3306	1:40pm	Right Carcinoma breast	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
139	1482956	64	Male	23-FS-68	FS-23-68	12:25pm	Bladder growth	SMALL	Right ureteric margin	resected margin status	Suspicious for malignancy
140	1482956	64	Male	23-FS-69	FS-23-69	12:25pm	Bladder growth	SMALL	Left ureteric margin	resected margin status	Suspicious of malignancy
141	1481362	45	Female	23-FS-70	23-3452	11:15am	Adnexal mass	Large	Right ovary	Primary diagnosis	Carcinoma
142	1489662	38	Female	23-FS-71	23-FS-71	1:32pm	Scar site ectopic	Large	Scar site ectopic	Primary diagnosis	No specific pathology
143	1461314	66	Female	23-FS-72	23-3761	10:40am	Ovarian cyst	Large	Left ovary	Primary diagnosis	Normal elements
144	1482015	39	Female	23-FS-73	23-3925	10:45am	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid Adenoma
145	1492903	43	Female	23-FS-74	23-3913	12:00 noon	Benign cyst	SMALL	Right ovary	Primary diagnosis	Normal elements
146	1492903	43	Female	23-FS-75	23-3914	12:00 noon	Benign cyst	SMALL	Left ovary	Primary diagnosis	Normal elements
147	1473999	25	Female	23-FS-76	23-4007, 23-3988	11:46am	Meningioma	SMALL	Brain	Primary diagnosis	Positive for tumor
148	1496701	60	Male	23-FS-77	FS-23-77	11:30am	Gall bladder carcinoma	SMALL	Distal margin	resected margin status	Free of tumor
149	1496701	60	Male	23-FS-78	FS-23-78	11:30am	Gall bladder carcinoma	SMALL	Proximal margin	resected margin status	Free of tumor
150	553850	80	Female	23-FS-79	23-4019	2:54pm	Superifical parotid	SMALL	Parotid gland	Primary diagnosis	Infective pathology
151	1496573	54	Female	23-FS-81	23-4083	1:15pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
152	1496573	54	Female	23-FS-81	23-4083	1:15pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
153	3998	53	Female	23-FS-83	23-4217	10:18am	Adnexal cyst	Large	Left ovary	Primary diagnosis	Normal elements
154	1502357	53	Female	23-FS-84	23-4640	11:35am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
155	1502357	53	Female	23-FS-85	23-4641	11:35am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
136	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	23 minutes	37 minutes	Yes, Level III lymph node dissection	Concordant	Concordant
137	Reactive hyperplasia	Reactive hyperplasia	23 minutes	37 minutes	Yes, Level III lymph node dissection	Concordant	Concordant
138	Reactive hyperplasia	Reactive hyperplasia	23 minutes	37 minutes	Yes, Level III lymph node dissection	Concordant	Concordant
139	Free of tumour	Free of tumour	15 minutes	20 minutes	NA	Discordant	Concordant
140	Free of tumour	Free of tumour	15 minutes	20 minutes	NA	Discordant	Concordant
141	Carcinoma	Endometroid carcinoma	23 minutes	33 minutes	Yes, Bilateral pelvic lymph nodes dissection and omentectomy	Concordant	Concordant
142	No specific pathology	No specific pathology	12 minutes	28 minutes	NA	Concordant	Concordant
143	Non neoplastic,NOS	Serous cystadenoma	36 minutes	38 minutes	NA	Discordant	Discordant
144	Parathyroid Adenoma	Parathyroid Adenoma	38 minutes	49 minutes	NA	Concordant	Concordant
145	Normal elements	Normal elements	21 minutes	37 minutes	Yes,Hysterectomy with bilateral salpingo-oophorectomy	Concordant	Concordant
146	Endometriosis	Serous cystadenoma	21 minutes	37 minutes	Yes,Hysterectomy with bilateral salpingo-oophorectomy	Discordant	Discordant
147	Neoplasm-Meningioma	Meningioma	19 minutes	32 minutes	Yes, Resection of part of brain	Concordant	Concordant
148	Free of tumor	Free of tumor	31 minutes	31 minutes	NA	Concordant	Concordant
149	Free of tumor	Free of tumor	31 minutes	31 minutes	NA	Concordant	Concordant
150	Cyst	Retention cyst	21 minutes	30 minutes	NA	Concordant	Concordant
151	Reactive hyperplasia	Reactive hyperplasia	48 minutes	65 minutes	NA	Concordant	Concordant
152	Reactive hyperplasia	Reactive hyperplasia	48 minutes	65 minutes	NA	Concordant	Concordant
153	Normal elements	Normal elements	20 minutes	25 minutes	NA	Concordant	Concordant
154	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	14 minutes	33 minutes	Yes, Level III lymph node dissection	Concordant	Concordant
155	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	14 minutes	33 minutes	Yes, Level III lymph node dissection	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
156	1502357	53	Female	23-FS-86	23-4642	11:35am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
157	1504750	61	Female	23-FS-87	23-4758	10:23am	Carcinoma ovary	Large	Left ovary	Primary diagnosis	Spindle cell neoplasm
158	1505842	63	Male	23-FS-88	23-4812	10:39am	Squamous cell carcinoma	SMALL	Left vocal cord mucosa	Primary diagnosis	Squamous cell carcinoma
159	1503759	63	Female	23-FS-89	23-FS-89	10:05am	Carcinoma buccal mucosa	SMALL	Buccal mucosa	Primary diagnosis	Squamous cell Carcinoma
160	1493227	70	Male	23-FS-90	FS-23-90	10:46am	Carcinoma head of pancreas	SMALL	Liver	Metastasis	No specific pathology
161	1506302	59	Female	23-FS-91	23-FS-91	1:11pm	Carcinoma head of pancreas	SMALL	Pancreatic duct margin	resected margin status	Free of tumor
162	1465897	56	Male	23-FS-92	FS-23-92	12:35am	Carcinoma stomach	SMALL	Proximal esophageal resected margn	resected margin status	Free of tumor
163	1428214	54	Female	23-FS-93	23-5083	3:35pm	Buccal Mucosa lesion	SMALL	Buccal mucosa	Primary diagnosis	Negative for malignancy
164	1511851	41	Female	23-FS-94	23-5181	1:31pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
165	1511851	41	Female	23-FS-95	23-5181	1:31pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
166	1511415	36	Female	23-FS-96	23-5492	1:48pm	Adnexal mass	Large	Right ovary	Primary diagnosis	Mucinous neoplasm
167	1513824	53	Female	23-FS-97	23-5318	3:12pm	Gall bladder carcinoma	SMALL	Gall bladder	Primary diagnosis	Carcinoma
168	408322	66	Male	23-FS-98	23-5393	12:10pm	Mass rectum	SMALL	Distal resected margin of rectum	resected margin status	Free of tumor
169	1511325	61	Female	23-FS-99	23-5545	12:15pm	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
170	1513971	53	Female	23-FS-100	23-5610	11:10am	Ovarian mass	Large	Left ovary	Primary diagnosis	Mucinous neoplasm
171	161209	49	Female	23-FS-101	23-FS-101	11:52am	Not available	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
172	1501515	77	Male	23-FS-102	23-5620	12:05pm	Stomach carcinoma	SMALL	Omentum	Metastasis	Metastatic carcinomatous deposits
173	1440314	52	Male	23-FS-103	23-103	11:15am	Gall bladder carcinoma	SMALL	Cystic duct margin	resected margin status	Free of tumor
174	1519138	65	Female	23-FS-104	23-5666	2:11pm	Lateral border of tongue lesion	SMALL	Tongue	Primary diagnosis	Positive for malignancy
175	1516955	53	Female	23-FS-105	23-5734	12:40pm	Left Breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
156	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	14 minutes	33 minutes	Yes, Level III lymph node dissection	Concordant	Concordant
157	Stromal tumor	Adult granulosa cell tumor	39 minutes	49 minutes	Yes,Hysterectomy with bilateral pelvic and para-aortic lymph node dissection	Concordant	Concordant
158	Squamous cell carcinoma	Squamous cell carcinoma	13 minutes	17 minutes	NA	Concordant	Concordant
159	Squamous cell carcinoma	Squamous cell carcinoma	12 minutes	25 minutes	NA	Concordant	Concordant
160	No specific pathology	No specific pathology	25 minutes	38 minutes	NA	Concordant	Concordant
161	Free of tumor	Free of tumor	10 minutes	17 minutes	NA	Concordant	Concordant
162	Free of tumor	Free of tumor	20 minutes	30 minutes	NA	Concordant	Concordant
163	Negative for malignancy	Negative for malignancy	24 minutes	34 minutes	NA	Concordant	Concordant
164	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	30 minutes	39 minutes	Yes, Right mastectomy with Level 1,2,3 lymph node dissection	Concordant	Concordant
165	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	30 minutes	39 minutes	Yes, Right mastectomy with Level 1,2,3 lymph node dissection	Concordant	Concordant
166	Mucinous carcinoma	Mucinous carcinoma ovary	20 minutes	32 minutes	Yes, Right salpingo- oophorectomy done	Concordant	Concordant
167	Adenocarcinoma	Carcinoma	13 minutes	23 minutes	Yes, Wedge resection of liver with cholecystectomy	Concordant	Concordant
168	Free of tumor	Free of tumor	22 minutes	48 minutes	NA	Concordant	Concordant
169	Reactive hyperplasia	Reactive hyperplasia	21 minutes	29 minutes	NA	Concordant	Concordant
170	Mucinous neoplasm	Mucinous cystadenoma	32 minutes	46 minutes	Yes, Hysterectomy with B/L salpingo-oohorectomy	Concordant	Concordant
171	Normal elements	Normal elements	26 minutes	45 minutes	NA	Concordant	Concordant
172	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	13 minutes	31 minutes	Yes, Gastrectomy	Concordant	Concordant
173	Free of tumor	Free of tumor	34 minutes	50 minutes	NA	Concordant	Concordant
174	Squamous cell carcinoma	Squamous cell carcinoma	17 minutes	22 minutes	Yes, excision of tongue, level 1-A LN dissection and Neck dissection	Concordant	Concordant
175	Reactive hyperplasia	Reactive hyperplasia	29 minutes	40 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
176	75631	43	Female	23-FS-106	23-5735	1:30pm	Bilateral adnexal mass	Large	Right ovary	Primary diagnosis	Carcinoma
177	1520714	42	Female	23-FS-107	23-5835	10:55am	Left adnexal mass	Large	Left ovary	Primary diagnosis	Carcinoma
178	1519664	63	Female	23-FS-108	23-5841	10:55am	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid Adenoma
179	1521193	60	Female	23-FS-109	23-109	12:20pm	Fibroid	SMALL	Endometrium	Primary diagnosis	Normal elements
180	1110905	55	Female	23-FS-110	23-5923	1:18pm	Infected TKR	SMALL	Right knee tissue	Infection	Infective pathology
181	150779	77	Male	23-FS-111	23-5933	11:38am	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid Adenoma
182	1487532	76	Female	23-FS-112	FS-23-112	12:08pm	Known case of Carcinoma gall bladder	SMALL	Cystic duct margin	resected margin status	Free of tumor
183	1519973	56	Female	23-FS-113	FS-23-113	11:15am	Endometrial hyperplasia	SMALL	Endometrial curretings	Primary diagnosis	Suspicious for malignancy
184	1525613	24	Female	23-FS-114	23-6272	11:00am	Carcinoma right ovary	Large	Right ovary	Primary diagnosis	Carcinoma
185	1527388	67	Female	23-FS-115	23-6395	1:11pm	Endometrial hyperplasia	SMALL	Endometrial curretings	Primary diagnosis	Suspicious for malignancy
186	1527914	39	Female	23-FS-116	23-6321	11:10am	Not available	Large	Left ovary	Primary diagnosis	Normal elements
187	1509053	64	Female	23-FS-117	23-6543	10:20am	Not available	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
188	231799	50	Female	23-FS-118	23-6697	4:01pm	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid adenoma
189	1528705	60	Female	23-FS-120	23-6729	11:52am	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
190	1528705	60	Female	23-FS-121	23-6730	11:52am	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
191	1528705	60	Female	23-FS-122	23-6731	12:07pm	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
192	1534416	46	Female	23-FS-123	23-6851	10:41am	Abnormal uterine bleeding	SMALL	Endometrium	Primary diagnosis	Normal elements
193	1326662	51	Female	23-FS-124	23-6928	10:51am	Not available	SMALL	Endometrial curretings	Primary diagnosis	Suspicious for malignancy
194	1533586	65	Female	23-125	23-FS-125	12:18pm	Endometrial carcinoma	SMALL	Endometrial curretings	Primary diagnosis	Malignant neoplasm

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
176	High grade carcinoma	High grade carcinoma	33 minutes	43 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy and iliac lymph node dissection	Concordant	Concordant
177	Carcinoma	Endometroid carcinoma	21 minutes	37 minutes	Yes,Hysterectomy with Bilateral salpingo-oophorectomy	Concordant	Concordant
178	Parathyroid adenoma	Parathyroid adenoma	23 minutes	41 minutes	NA	Concordant	Concordant
179	Normal elements	Normal elements	22 minutes	38 minutes	Yes,Hysterectomy with bilateral salpingo-oophorectomy	Concordant	Concordant
180	Inflammatory pathology	Inflammatory pathology	14 minutes	26 minutes	NA	Concordant	Concordant
181	Parathyroid adenoma	Parathyroid adenoma	37 minutes	46 minutes	NA	Concordant	Concordant
182	Free of tumor	Free of tumor	13 minutes	26 minutes	Yes, wedge resection of liver and lymph node dissection done	Concordant	Concordant
183	Endometrial hyperplasia	Benign endometrial polyp	21 minutes	34 minutes	Yes, Hysterectomy with salpingoophorectomy	Discordant	Discordant
184	Borderline surface epithelial tumor	Low grade serous carcinoma right ovary	36 minutes	55 minutes	NA	Concordant	Discordant
185	Normal elements	Benign endometrial polyp	35 minutes	47 minutes	Yes, hystectomy with Bilateral salpingo-oophorectomy	Discordant	Discordant
186	Normal elements	Endometriosis	16 minutes	40 minutes	Yes, Hysterectomy with B/L salpingooophorectomy done	Discordant	Discordant
187	Deferred	Normal elements	24 minutes	26 minutes	Yes, Hysterectomy with Bilateral salpingo-oophorectomy	Concordant	Discordant
188	Parathyroid adenoma	Parathyroid adenoma	14 minutes	31 minutes	Yes, Total parathyroidectomy	Concordant	Concordant
189	Reactive hyperplasia	Reactive hyperplasia	26 minutes	33 minutes	Yes, Left mastectomy	Concordant	Concordant
190	Reactive hyperplasia	Reactive hyperplasia	26 minutes	33 minutes	Yes, Left mastectomy	Concordant	Concordant
191	Reactive hyperplasia	Reactive hyperplasia	11 minutes	25 minutes	Yes, Left mastectomy	Concordant	Concordant
192	Normal elements	Normal elements	27 minutes	34 minutes	Yes, hysterectomy with Bilateral oophorectomy	Concordant	Concordant
193	Endometrial hyperplasia	Secretory endometrium	25 minutes	34 minutes	Yes, Hysterectomy	Discordant	Discordant
194	Malignant neoplasm	High grade malignant neoplasm	27 minutes	39 minutes	NA	Concordant	Concordant

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195	1552973	63	Female	23-FS-126	23-7043, 7063	10:58am	Endometrial hyperplasia	SMALL	Endometrium	Primary diagnosis	Malignant neoplasm
196	1513591	50	Female	FS-23-127	23-7056	2:38pm	Bladder Carcinoma	SMALL	Urinary bladder	Primary diagnosis	Positive for malignancy
197	1513591	50	Female	FS-23-128	23-7057	2:38pm	Bladder Carcinoma	SMALL	Urinary bladder	Primary diagnosis	Positive for malignancy
198	1535539	75	Female	FS-23-129	23-7249	10:38am	Endometrial hyperplasia	SMALL	Endometrium	Primary diagnosis	Carcinoma
199	1539830	57	Female	FS-23-130	23-7390	2:46pm	Uterine fibroids,Abdominal mass	Large	Hysterectomy specimen	Primary diagnosis	Spindle cell neoplasm
200	1520305	57	Female	FS-23-131	FS-23-131	10:08am	Endometrial hyperplasia	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
201	1539268	59	Male	FS-23-132	23-7547	9:32am	Carcinoma buccal mucosa	SMALL	Left buccal mucosa	Primary diagnosis	Carcinoma
202	1500034	38	Female	FS-23-133	FS-23-133	12:03pm	Carcinoma stomach	SMALL	Proximal gastrectomy margin	resected margin status	Free of tumour
203	1500034	38	Female	FS-23-134	FS-23-134	12:03pm	Carcinoma stomach	SMALL	Proximal gastrectomy margin	resected margin status	Free of tumour
204	1542016	68	Female	FS-23-135	23-7581	12:45pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
205	1542016	68	Female	FS-23-136	23-7582	12:45pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
206	1534759	52	Female	FS-23-137	23-7637	10:15am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
207	1534759	52	Female	FS-23-138	23-7638	10:15am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
208	1534759	52	Female	FS-23-139	23-7640	10:15am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
209	1543618	48	Female	23-FS-140	23-7647	2:13pm	Ovarian mass	Large	Right ovary	Primary diagnosis	Non neoplastic,NOS
210	1541862	42	Female	23-FS-141	23-7697	11:48am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
211	1541862	42	Female	23-FS-142	23-7698	11:48am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
212	1533693	64	Male	23-FS-143	23-FS-143	11:11am	Cholangio carcinoma	SMALL	Liver	Metastasis	No evidence of malignancy
213	1545792	49	Male	23-FS-144	23-7865	10:11am	Cholecystitis	Large	Gall bladder	Primary diagnosis	No evidence of malignancy

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
195	Malignant neoplasm	Carcinosarcoma	20 minutes	34 minutes	Yes, total hysterectomy with bilateral salpingo oophorectomy and pelvic lymph node dissection	Concordant	Concordant
196	Urothelial carcinoma	Invasive papillary urothelial carcinoma	23 minutes	32 minutes	NA	Concordant	Concordant
197	Urothelial carcinoma	Invasive papillary urothelial carcinoma	23 minutes	32 minutes	NA	Concordant	Concordant
198	Endometroid adenocarcinoma	Endometroid adenocarcinona	22 minutes	32 minutes	Yes,Hysterectomy with bilateral salpingo-oophrorectomy	Concordant	Concordant
199	Stromal tumor	Ovarian fibroma	22 minutes	29 minutes	Yes,Hysterectomy with bilateral salpingo-oophorectomy and pelvic lymph mode dissection	Concordant	Concordant
200	Normal elements	Normal elements	24 minutes	49 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy	Concordant	Concordant
201	Squamous cell carcinoma	Squamous cell carcinoma	16 minutes	28 minutes	Yes, Left buccal mucosa composite resection with neck lymph node dissection	Concordant	Concordant
202	Free of tumour	Free of tumour	23 minutes	37 minutes	NA	Concordant	Concordant
203	Free of tumour	Free of tumour	23 minutes	37 minutes	NA	Concordant	Concordant
204	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	16 minutes	31 minutes	Yes, Right mastectomy and level I, II, III lymph node dissection	Concordant	Concordant
205	Reactive hyperplasia	Reactive hyperplasia	16 minutes	31 minutes	Yes, Right mastectomy and level I, II, III lymph node dissection	Concordant	Concordant
206	Reactive hyperplasia	Reactive hyperplasia	15 minutes	27 minutes	Yes, Left breast conservative surgery	Concordant	Concordant
207	Reactive hyperplasia	Reactive hyperplasia	15 minutes	27 minutes	Yes, Left breast conservative surgery	Concordant	Concordant
208	Reactive hyperplasia	Reactive hyperplasia	15 minutes	27 minutes	Yes, Left breast conservative surgery	Concordant	Concordant
209	Dermoid cyst	Mature cystic teratoma	19 minutes	35 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy	Discordant	Concordant
210	Reactive hyperplasia	Reactive hyperplasia	28 minutes	34 minutes	Yes, Left modified radical mastectomy	Concordant	Concordant
211	Reactive hyperplasia	Reactive hyperplasia	28 minutes	34 minutes	Yes, Left modified radical mastectomy	Concordant	Concordant
212	No evidence of malignancy	No evidence of malignancy	21 minutes	36 minutes	Yes, cholecystectomy	Concordant	Concordant
213	No evidence of malignancy	No evidence of malignancy,chronic cholecystitis	19 minutes	31 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
214	1543147	37	Female	23-FS-145	FS-23-145	12:15pm	Endometriosis	Large	Endometrium	Primary diagnosis	Normal elements
215	1542878	44	Female	23-FS-146	23-FS-146	1:42pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
216	1542878	44	Female	23-FS-147	23-FS-147	1:42pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
217	1549901	58	Female	23-FS-148	23-FS-148	2:45pm	Ovarian mass	Large	Left ovary	Primary diagnosis	Mucinous neoplasm
218	1546200	43	Male	23-FS-149	23-8319	11:30am	Warthin's tumor	SMALL	Parotid gland	Primary diagnosis	Partoid lesion
219	1098704	48	Female	23-FS-150	23-8268	12:57pm	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
220	1098704	48	Female	23-FS-151	23-8269	12:57pm	Left breast lump	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
221	1547016	47	Female	23-FS-152	FS-23-152	12:56pm	Endometrial bleeding	SMALL	Endometrium	Primary diagnosis	Normal elements
222	1542512	40	Female	23-FS-153	23-8312	12:25pm	Right Breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
223	1542512	40	Female	23-FS-154	23-8313	12:25pm	Right Breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
224	1513591	50	Female	FS-23-155	FS-23-155	12:15pm	Carcinoma bladder	SMALL	Left ureteric margin	resected margin status	Free of tumor
225	1513591	50	Female	FS-23-156	FS-23-156	12:15pm	Carcinoma bladder	SMALL	Right ureteric margin	resected margin status	Free of tumor
226	1553779	68	Female	FS-23-157	23-FS-157	11:43am	Carcinoma pancreas	SMALL	Pancreatic neck margin	resected margin status	Free of tumor
227	1553779	68	Female	FS-23-158	23-FS-158	11:43am	Carcinoma pancreas	SMALL	Pancreatic tail margin	resected margin status	Free of tumor
228	160518	48	Male	FS-23-159	23-FS-159	1:38pm	Parathyroid adenoma	SMALL	Parathyroid gland	Primary diagnosis	Parathyroid adenoma
229	1550018	51	Female	FS-23-160	FS-23-160	11:30pm	Gall bladder carcinoma	SMALL	Duodenum	Metastasis	Deferred
230	1550268	59	Male	FS-23-161	FS-23-161	12:22pm	Bladder growth	SMALL	Right ureteric margin	resected margin status	Free of tumor
231	1550268	59	Male	FS-23-162	FS-23-162	12:22pm	Bladder growth	SMALL	Left ureteric margin	resected margin status	Free of tumor
232	1550890	53	Female	23-FS-163	23-8814	11:01am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
233	1550890	53	Female	23-FS-164	23-8815	11:01am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
214	Normal elements	Normal elements	12 minutes	24 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy	Concordant	Concordant
215	Reactive hyperplasia	Reactive hyperplasia	23 minutes	30 minutes	Yes, Left breast lumpectomy	Concordant	Concordant
216	Reactive hyperplasia	Reactive hyperplasia	23 minutes	30 minutes	Yes, Left breast lumpectomy	Concordant	Concordant
217	Mucinous neoplasm	Mucinous cystadenoma	21 minutes	36 minutes	NA	Concordant	Concordant
218	Tumor	Mucoepidermoid carcinoma	46 minutes	68 minutes	Yes, Parotidectomy	Concordant	Concordant
219	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	20 minutes	32 minutes	Yes, Left mastectomy ,Left axillary lymph node and level III lymph node dissection	Concordant	Concordant
220	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	20 minutes	32 minutes	Yes, Left mastectomy ,Left axillary lymph node and level III lymph node dissection	Concordant	Concordant
221	Normal elements	Normal elements	20 minutes	33 minutes	Yes, Hysterectomy with bilateral salpingo-oopherechony	Concordant	Concordant
222	Reactive hyperplasia	Reactive hyperplasia	17 minutes	27 minutes	Yes, wide excision right breast	Concordant	Concordant
223	Reactive hyperplasia	Reactive hyperplasia	17 minutes	27 minutes	Yes, wide excision right breast	Concordant	Concordant
224	Free of tumour	Free of tumour	43 minutes	54 minutes	NA	Concordant	Concordant
225	Free of tumour	Free of tumour	43 minutes	54 minutes	NA	Concordant	Concordant
226	Free of tumour	Free of tumour	25 minutes	33 minutes	Yes, spleen preserving distal pancreactomy	Concordant	Concordant
227	Free of tumour	Free of tumour	25 minutes	33 minutes	Yes, spleen preserving distal pancreactomy	Concordant	Concordant
228	Parathyroid adenoma	Parathyroid adenoma	14 minutes	22 minutes	Yes, removal of right parathyorid	Concordant	Concordant
229	Deferred	No evidence of malignancy	30 minutes	37 minutes	Yes, wedge resection of liver with cholecystectomy	Discordant	Discordant
230	Free of tumour	Free of tumour	29 minutes	38 minutes	NA	Concordant	Concordant
231	Free of tumour	Free of tumour	29 minutes	38 minutes	NA	Concordant	Concordant
232	Reactive hyperplasia	Reactive hyperplasia	18 minutes	35 minutes	NA	Concordant	Concordant
233	Reactive hyperplasia	Reactive hyperplasia	18 minutes	35 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
234	1555033	59	Female	23-FS-165	23-8819	12:25pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
235	1555033	59	Female	23-FS-166	23-8820	12:25pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
236	1555033	59	Female	23-FS-167	23-8821	12:25pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
237	1556674	70	Female	23-FS-168	23-8881	1:11pm	Right breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
238	1554395	66	Female	23-FS-169	23-8920	12:15pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
239	1554395	66	Female	23-FS-170	23-8921	12:15pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
240	1554395	66	Female	23-FS-171	23-8922	12:15pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
241	1562421	57	Female	FS-23-172	23-9088	12:26pm	Endometrial carcinoma	SMALL	Endometrium	Primary diagnosis	Carcinoma
242	1562459	61	Male	23-FS-173	23-9255	2:45pm	Alveolar carcinoma	SMALL	Left upper alveolus	Primary diagnosis	Squamous cell carcinoma
243	1563822	35	Female	FS-23-174	23-9251	12:30pm	Benign cyst	Large	Left ovary	Primary diagnosis	Non neoplastic,NOS
244	1559830	60	Female	FS-23-175	23-9396	10:15am	Ovarian cyst	Large	Ovary	Primary diagnosis	Non neoplastic,NOS
245	1556420	47	Female	23-FS-176	FS-23-176 Left over	10:45am	Not available	Large	Endometrium	Primary diagnosis	Normal elements
246	85302	45	Female	23-FS-177	23-9582	12:15pm	Endometrial hyperplasia	SMALL	Endometrial curretings	Primary diagnosis	Normal elements
247	1504087	61	Male	FS-23-178	Fs-23-178 left over	1:28pm	Carcinoma	SMALL	Bile duct margin	resected margin status	Positive for malignancy
248	1568375	20	Female	23-FS-179	23-9625	11:48am	AV malformation	Large	Right Thigh	Primary diagnosis	Epitheloid tumor
249	1569361	41	Female	23-FS-180	23-9682	3:15pm	Left ovarian cyst	Large	Left ovary	Primary diagnosis	Non neoplastic,NOS
250	1520144	72	Male	23-FS-181	FS-23-181 Left over	11:50am	Bladder carcinoma	SMALL	Right ureteric margin	resected margin status	Free of tumor
251	1520144	72	Male	23-FS-182	FS-23-182 Left over	11:50am	Bladder carcinoma	SMALL	Left ureteric margin	resected margin status	Free of tumor
252	1568352	75	Male	23-FS-183	FS-23-183 left over	2:05pm	Bladder carcinoma	SMALL	Right ureteric margin	resected margin status	Free of tumor
253	1568352	75	Male	23-FS-184	FS-23-184 left over	2:05pm	Bladder carcinoma	SMALL	Left ureteric margin	resected margin status	Free of tumor

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
234	Reactive hyperplasia	Reactive hyperplasia	20 minutes	33 minutes	NA	Concordant	Concordant
235	Reactive hyperplasia	Reactive hyperplasia	20 minutes	33 minutes	NA	Concordant	Concordant
236	Reactive hyperplasia	Reactive hyperplasia	20 minutes	33 minutes	NA	Concordant	Concordant
237	Reactive hyperplasia	Reactive hyperplasia	15 minutes	35 minutes	NA	Concordant	Concordant
238	Reactive hyperplasia	Reactive hyperplasia	15 minutes	25 minutes	Yes, Left mastectomy and level I, II, III lymph node dissection	Concordant	Concordant
239	Metastatic carcinomatous deposits	Metastatic carcinomatous deposits	15 minutes	25 minutes	Yes, Left mastectomy and level I, II, III lymph node dissection	Discordant	Concordant
240	Reactive hyperplasia	Reactive hyperplasia	15 minutes	25 minutes	Yes, Left mastectomy and level I, II, III lymph node dissection	Concordant	Concordant
241	Endometrioid carcinoma	Endometrioid carcinoma	23 minutes	34 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy and pelvic lymph node dissection	Concordant	Concordant
242	Squamous cell carcinoma	Squamous cell carcinoma	16 minutes	18 minutes	Yes, Left maxillectomy	Concordant	Concordant
243	Non-neoplastic,NOS	Endometriotic cyst	18 minutes	29 minutes	NA	Concordant	Concordant
244	Non neoplastic,NOS	Benign cystic lesion	23 minutes	33 minutes	Yes, Hysterectomy with bilateral salpingo - oophorectomy	Concordant	Concordant
245	Normal elements	Normal elements	23 minutes	33 minutes	Yes, Hysterectomy with bilateral salpingo - oophorectomy	Concordant	Concordant
246	Normal elements	Normal elements	20 minutes	25 minutes	Yes, Hysterectomy with bilateral salpingo-oopherectomy done	Concordant	Concordant
247	Adenocarcinoma	Adenocarcinoma	16 minutes	30 minutes	Yes,Hepatoduodenal lymph node dissection	Concordant	Concordant
248	Epitheloid tumor	Alveolar soft part sarcoma	23 minutes	38 minutes	Yes, Soft tissue tumor removal	Concordant	Concordant
249	Non neoplastic,NOS	Serous cystadenofibroma	24 minutes	35 minutes	Yes, Hysterectomy with bilateral salpingo-oophorectomy	Discordant	Discordant
250	Free of tumor	Free of tumor	25 minutes	36 minutes	NA	Concordant	Concordant
251	Free of tumor	Free of tumor	25 minutes	36 minutes	NA	Concordant	Concordant
252	Free of tumor	Free of tumor	24 minutes	34 minutes	NA	Concordant	Concordant
253	Free of tumor	Free of tumor	24 minutes	34 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
254	1567087	44	Female	FS-23-185	23-10031	3:20pm	Salivary gland tumor	Large	Parotid gland	Primary diagnosis	Suspicious of malignancy
255	1032108	44	Female	23-FS-186	23-10118	1:57pm	Complex ovarian cyst	Large	Left ovary	Primary diagnosis	Non neoplastic,NOS
256	1032108	44	Female	23-FS-187	23-10118	1:57pm	Hemorrhagic cyst	Large	Right ovary	Primary diagnosis	Non neoplastic,NOS
257	315366	40	Female	FS-23-188	23-10178	1:55pm	Ovarian cyst	Large	Right ovary	Primary diagnosis	Dermoid cyst
258	1209784	74	Male	FS-23-189	FS-23-189 Left over	11:32am	Bladder growth	SMALL	Right ureteric margin	resected margin status	Free of tumor
259	1209784	74	Male	FS-23-190	FS-23-190 Left over	11:32am	Bladder growth	SMALL	Left ureteric margin	resected margin status	Free of tumor
260	1552620	23	Male	FS-23-191	FS-23-191 Left over	1:45pm	Sarcoma	SMALL	Proximal femur margin	resected margin status	Free of tumor
261	1527636	69	Male	FS-23-192	FS-23-192 Lef over	2:05pm	Infected TKR	SMALL	Knee tissue	Infection	No significant neutrophils
262	1573089	71	Male	FS-23-193	FS-23-193 Left over	10:24am	Peri ampullary carcinoma	SMALL	Bowel nodule	Metastasis	Metastatic carcinomatous deposits
263	1580409	48	Female	FS-23-194	FS-23-194 Left Over	10:45am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
264	1580409	48	Female	FS-23-195	FS-23-195 Left Over	10:45am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
265	1580409	48	Female	FS-23-196	FS-23-196	10:45am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
266	1580409	48	Female	FS-23-197	FS-23-197	10:45am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Metastatic carcinomatous deposits
267	1578316	66	Female	FS-23-198	23-10525	11:12am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
268	1578316	66	Female	FS-23-199	23-10526	11:12am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
269	1578316	66	Female	FS-23-200	23-10527	11:12am	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
270	1580624	36	Male	FS-23-201	FS-23-201 Left over	11:37am	Hilar cholangiocarcinoma	SMALL	Left hepatic duct margin	resected margin status	Free of tumor
271	1580624	36	Male	FS-23-202	FS-23-202 Left over	11:37am	Hilar cholangiocarcinoma	SMALL	Right anterior hepatic duct margin	resected margin status	Free of tumor
272	1580624	36	Male	FS-23-203	FS-23-203 Left over	11:37am	Hilar cholangiocarcinoma	SMALL	Right posterior hepatic duct margin	resected margin status	Free of tumor
273	1585643	60	Male	FS-23-205	23-10935	11:12am	Xanthogranulomatous cholecystitis	Large	Gall bladder	Primary diagnosis	Xanthogranulomatous cholecystitis

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
254	Neoplasm	Acinic cell carcinoma	16 minutes	28 minutes	Yes, superifical parotidectomy	Concordant	Concordant
255	Hemorrhagic cyst	Hemorrhagic cyst	17 minutes	31 minutes	Yes, Hysterectomy	Concordant	Concordant
256	Hemorrhagic cyst	Hemorrhagic cyst	17 minutes	31 minutes	Yes, Hysterectomy	Concordant	Concordant
257	Dermoid cyst	Mature cystic teratoma	20 minutes	24 minutes	Yes, Right ovarain cyst removal	Concordant	Concordant
258	Free of tumor	Free of tumor	42 minutes	56 minutes	NA	Concordant	Concordant
259	Free of tumor	Free of tumor	42 minutes	56 minutes	NA	Concordant	Concordant
260	Free of tumor	Free of tumor	24 minutes	35 minutes	NA	Concordant	Concordant
261	No significant neutrophils	No significant neutrophils	28 minutes	40 minutes	NA	Concordant	Concordant
262	Metastatic carcionomatous deposits	Metastatic carcinomatous deposits	28 minutes	34 minutes	NA	Concordant	Concordant
263	Metastatic carcionomatous deposits	Metastatic carcinomatous deposits	35 minutes	44 minutes	Yes, Left mastectomy and Level III lymph node dissection	Concordant	Concordant
264	Metastatic carcionomatous deposits	Metastatic carcinomatous deposits	35 minutes	44 minutes	Yes, Left mastectomy with Level III lymph node dissection	Discordant	Concordant
265	Reactive hyperplasia	Reactive hyperplasia	35 minutes	44 minutes	Yes, Left mastectomy with Level III lymph node dissection	Concordant	Concordant
266	Metastatic carcionomatous deposits	Metastatic carcinomatous deposits	35 minutes	44 minutes	Yes, Left mastectomy with Level III lymph node dissection	Concordant	Concordant
267	Reactive hyperplasia	Reactive hyperplasia	10 minutes	36 minutes	NA	Concordant	Concordant
268	Reactive hyperplasia	Reactive hyperplasia	10 minutes	36 minutes	NA	Concordant	Concordant
269	Reactive hyperplasia	Reactive hyperplasia	10 minutes	36 minutes	NA	Concordant	Concordant
270	Free of tumor	Free of tumor	24 minutes	38 minutes	NA	Concordant	Concordant
271	Free of tumor	Free of tumor	24 minutes	38 minutes	NA	Concordant	Concordant
272	Free of tumor	Free of tumor	24 minutes	38 minutes	NA	Concordant	Concordant
273	Xanthogranulomatous cholecystitis	Xanthogranulomatous cholecystitis	17 minutes	26 minutes	NA	Concordant	Concordant

Sr. No.	MRD No.	Age	Sex	Frozen Section No. & Imprint Cytology No.	Histopath No.	Time of Specimen Received for frozen section	Clinical Diagnosis	Type of Specimen_Large	Site of Specimen	Indications of doing frozen section	Final diagnosis-Imprint Cytology
274	1586038	46	Female	FS-23-206	23-10978	12:50pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
275	1586038	46	Female	FS-23-207	23-10979	12:50pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
276	1587339	50	Female	FS-23-208	23-11029, 23-11080	11:05am	Cholelithiasis	SMALL	Gall bladder	Primary diagnosis	Xanthogranulomatous cholecystitis
277	486611	73	Female	FS-23-209	23-11038	1:25pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
278	486611	73	Female	FS-23-210	23-11039	1:25pm	Left breast carcinoma	SMALL	Sentinel lymph node	Metastasis	Reactive hyperplasia
279	1514228	59	Male	FS-23-211	FS-23-211	11:55am	Cholangiocarcinoma	SMALL	Proximal bile duct margin	resected margin status	Free of tumor
280	447797	48	Female	FS-23-212	FS-23-212	1:22pm	Endometrial polyp	SMALL	Endometrium	Primary diagnosis	Normal elements
281	615545	40	Female	FS-23-213	23-11165	10:45am	Not available	SMALL	Cervix	Primary diagnosis	No evidence of malignancy

Sr. No.	Final diagnosis-Frozen section	Final diagnosis-Histopathology	Time taken for diagnosis-Imprint Cytology	Time taken for diagnosis-Frozen section	Change in surgical management	Imprint cytology concordance	Frozen section concordance
274	Reactive hyperplasia	Reactive hyperplasia	33 minutes	42 minutes	NA	Concordant	Concordant
275	Reactive hyperplasia	Reactive hyperplasia	33 minutes	42 minutes	NA	Concordant	Concordant
276	Xanthogranulomatous cholecystitis	Xanthogranulomatous cholecystitis	31 minutes	35 minutes	NA	Concordant	Concordant
277	Reactive hyperplasia	Reactive hyperplasia	30 minutes	39 minutes	Yes, Left modified radical mastectomy	Concordant	Concordant
278	Reactive hyperplasia	Reactive hyperplasia	30 minutes	39 minutes	Yes, Left modified radical mastectomy	Concordant	Concordant
279	Free of tumor	Free of tumor	24 minutes	31 minutes	NA	Concordant	Concordant
280	Normal elements	Normal elements	23 minutes	36 minutes	Yes, Hysterectomy with bilateral salphingectomy	Concordant	Concordant
281	No evidence of malignancy	No evidence of malignancy	43 minutes	47 minutes	Yes, Hysterectomy with salpingectomy	Concordant	Concordant

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Date 5/1/24

The Principal
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Subject:- Approval of Plan of Thesis.

This is to inform you that the Faculty of Medical Sciences in its meeting held on 25.09.2023 has approved the plan of thesis of **Supreet Kour**, a student of your college for MD Pathology along with the names of Supervisor/Co-Supervisor as under:-

Topic Plan of Thesis
Comparative analysis of imprint cytology and frozen section with histopathology.

Supervisor	Co-Supervisor:-	Co-Supervisor:-
Dr. Puneet Kaur Sethi	Dr. Sumit Grover	Dr. Rachna Tyagi
Professor	Assoc. Prof.,	Assoc. Prof.
Dept. of Pathology	Dept. of Pathology	Dept. of Pathology

The student may submit the thesis in triplicate alongwith the plan in triplicate also, to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She may be directed to attach a photocopy of this letter with the forwarding letter while submitting thesis in the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic, if any.

Controller of Examinations

Note :

1. *If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY

THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED IN

PARTIAL FULFILMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

MD

In

PATHOLOGY

OF THE

BABA FARID UNIVERSITY OF HEALTH SCIENCES

FARIDKOT

AUGUST, 2022

DR. SUPREET KAUR

DEPARTMENT OF PATHOLOGY

DAYANAND MEDICAL COLLEGE AND HOSPITAL

LUDHIANA

ABSTRACT OF PLAN OF THESIS

Title	COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY
For the degree of	MD (PATHOLOGY)
Name of the candidate	Dr. Supreet Kaur
Supervisor	Dr. Pavneet Kaur Selhi, Professor, Department of Pathology, DMCH, Ludhiana
Co-supervisor(s)	Dr. Sumit Grover, Associate Professor, Pathology, DMCH, Ludhiana Dr. Ruchita Tyagi, Associate Professor, Pathology, DMCH, Ludhiana
Institution	Dayanand Medical College and Hospital, Ludhiana
University	Baba Farid University of Health Sciences, Faridkot

Introduction: Tissue specimens taken from the patient during the surgery (frozen section and imprint cytology) will be studied and then correlated with the final histological examination.

Aims & Objectives To compare diagnostic accuracy of imprint cytology and frozen section with the gold standard histopathological evaluation on formalin fixed paraffin embedded tissue.

Material & Methods: All the tissues received in the Department of Pathology of Dayanand Medical College and Hospital for frozen section and imprint cytology over a period of 1 year (from 15th September 2022 to 14th September 2023) and excised tissues received from the same organ and patient for histopathological evaluation for comparison.

Clinical Significance: To obtain a good database for accuracy of the diagnosis of frozen section and imprint cytology by comparing it with the histological findings.

Keywords: Frozen section, imprint cytology, Histological findings

(Signature) Candidate	(Signature) Co-supervisor	(Signature) Co-supervisor	(Signature) Supervisor	(Signature) Principal

CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY"** exist in the Department of Pathology, DMC&H, Ludhiana and will be provided to the candidate. We will see that the data being included in the thesis is genuine and is collected by the candidate herself under our supervision and guidance.

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APPROVAL PROFORMA
BY RESEARCH & ETHICAL COMMITTEE
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Topic of Thesis	COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY
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Date of enrollment	7th March, 2022
Name of Head of Department	Dr. Harpreet Kaur
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Dr. Harpreet Kaur (Professor & Head, Pathology)	Mr. R K Sharma (Legal Expert)
Dr. Jaspal Singh (Professor & Head, Surgery)	Dr. Ramit Mahajan (Associate Professor, Gastroenterology)
Dr. Dinesh Gupta (Professor & Head, Medicine)	Dr. Anu Sharma (Professor, Anatomy)
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Dr. Sandeep Puri
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Approved: Yes / ~~No~~

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PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

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2	NAME OF THE INSTITUTE	DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA
3	COURSE OF STUDY AND SUBJECT	MD Pathology
4	DATE OF ADMISSION OF COURSE	07-03-2022
5	TITLE OF THE TOPIC	COMPARATIVE ANALYSIS OF IMPRINT CYTOLOGY AND FROZEN SECTION WITH HISTOPATHOLOGY

6. BRIEF RESUME OF THE INTENDED WORK

6.1 NEED FOR THE STUDY

Providing an accurate and timely diagnosis is an important necessity and need of the hour in the current era of personalized medicine and superspecialization. Pathologists have an important role to play in the surgical management of various diseases because of the increasing use of frozen section and intraoperative imprint cytology.

Imprint cytology, which was introduced in 1927 by Dudgeon and Patrick, is an intraoperative and perioperative tissue assessment technique.[1] Intraoperative touch imprint cytology technique does not involve the freezing of tissue. Samples are obtained by touch imprints of fresh specimens. The principle of imprint cytology is based on a lack of cohesion amongst malignant tumors. The cells are stained by rapid staining. Strong indications for imprint cytology are lymphoproliferative lesions, central nervous system lesions and thyroid nodules. Imprint cytology can also be used for minute specimens and to sample tissue that would be difficult to cut with the cryostat.

Frozen tissue is a rapid method that can be used to harden tissue sufficient to allow thin sectioning. With the advancement of a modern reliable frozen section technique, intraoperative problems can be addressed immediately. Lang apparently first employed the use of freezing to harden tissues in the nineteenth century. De Riemer in 1818 made the pioneering effort of using this technique for histopathological diagnosis.[2]

Interpretation of frozen section and imprint cytology is an intricate process that requires clinical, laboratory, imaging findings with histopathological knowledge. Key quality components include application, precision and timeliness.[3] Imprint cytology and frozen section provide precise results in minutes while the patient is still under anesthesia. Both have a definitive role when cytological/whole biopsy

findings are inconclusive, in the evaluation of margins and intra-operative nodal status. Though frozen section tissue architecture strongly approximates histopathological paraffin sections, it is frequently hampered by freezing artifacts that may impair morphological assessment of the lesion. Imprint cytology provides better results with crisp cellular details and is a useful adjunctive technique that complements frozen section analysis of the lesion at the time of intra operative consultation. So, both imprint cytology and frozen section are dependable intraoperative consultation diagnostic modalities.

Thus, a study to show features and correlation of results of imprint cytology and frozen section with standard histopathological diagnosis will be helpful and will improve the confidence of the pathologist to perform either procedure in isolation or together to improve the outcome of the test.

Intraoperative cytology by touch imprints and frozen section of excised biopsy are two frequently employed techniques for rapid diagnosis and taking rational decisions for patient management.

Reasons for performing imprint cytology and frozen section are many, few of which are summarized below.

1) To establish the nature of a lesion, whether it is neoplastic or non neoplastic and further whether it is benign or malignant. It is very important to the operating surgeon, as this will decide the type of operative procedure or if further sampling is needed.

2) To analyse a lesion in a surgically suspicious area and to ascertain the presence of another lesion spotted unexpectedly during an operation.

3) To determine if the resected margins are free of tumor.

4) To establish the spread to the regional lymph nodes. It is also sometimes used to ascertain metastasis to a distant organ.
The advantage of touch imprint cytology is that it is simple, quick (2-3 minutes), safe (no loss of diagnostic material), inexpensive and possibly surveys the entire surface area of lesions.
The advantage of frozen section is that it is quick and safe.

This present study is intended to analyse know the various indications of doing imprint cytology and frozen section in our setting and to determine the accuracy and sensitivity of both by correlating it with the final histopathology report, histopathology being the gold standard.

6.2 REVIEW OF LITERATURE

Early Frozen section techniques were difficult and demanding, and required as much art as science.[4]It is a tribute to men like Hazard, Stevenson, and Dockerty that the procedure was accepted.[5,6] The technique introduced by Hazard and Stevenson in 1949 is fascinating compared to modern procedures using the cryostat, in which the fresh specimen was placed in a fixative ten times its volume and heated to about just the boiling point. The fixed block was then frozen between pieces of dry ice and cut at 10–15 um with a microtome knife. Each section was transferred to a beaker of distilled water. The section was then carried by a glass rod into a beaker containing carbol fuchsin and toluidine blue solution. After repeated washing in a series of beakers containing distilled water, the section is mounted onto a clean glass slide and immediately covered with 30% of sucrose or cane sugar and the cover slipped. This preparation lasted for one hour and if the coverslip was rimmed with Permount or flexible collodion, the section could be preserved for several days.

Dockerty in 1953 introduced a slight variation to the Hazard and Stevenson technique in which he froze the tissue, unfixed, directly to a Spencer microtome and all movements of the 10–15 um section except the first one was by glass stirring rod. Teloh HA [2] basically perfected the technique in 1957 by directly placing the unfixed specimen onto the freezing stage of the microtome and subjected the tissue to intermittent release of carbon dioxide gas causing rapid freezing, then cutting the tissue at 25um and stained using a drop of aqueous thionin solution. The thionin stain however faded away after 48 hours. For the permanent section, Teloh suggested the section be subjected to a few drops of 95% alcohol and stained using the haematoxylin and eosin (H&E) technique used for the paraffin-embedded tissue section. Slides prepared by this method could be preserved indefinitely.

The development of a cryomicrotome popularly known as cryostat in

1959, has revolutionized the frozen section technique. The cryostat is a refrigerated box containing a rotary microtome. The temperature inside the cryostat is about −20° to −30° Celsius. The attending technologist processes the tissue section by freezing it with frozen aerosol sprays and by putting it onto the cryostat for sectioning. Both intercellular and intracellular water is frozen to produce a hard matrix to enable slicing of the tissue. The tissue sections are cut and picked up on glass slides, which are then ready for staining.

The whole process, if all goes well, takes about 5–10 minutes. This is just to prepare the slides; the time the pathologist takes to study it under the microscope and arrive at a diagnosis is in addition to this. In one study involving 700 laboratories worldwide, it was found that 90% of frozen section block turn around times was within 20 minutes, measured from the time the pathologists received the specimens to the time that pathologists returned diagnoses to surgeons.[7]

Imprint cytology as well as frozen section has been used in cases of the parathyroid tissue, sentinel lymphnodes [8], adenomatous goiter, meningiomas[9,10], gliomas[11] , basal carcinomas of the skin, ovarian cancers[12], breast cancers [13-15] and salivary gland tumors such as mixed parotid tumors[16], pleomorphic adenoma and mucoepidermoid carcinoma.[17]

Authors have conducted studies worldwide to compare frozen section and imprint cytology with the standard histopathology diagnosis after tissue fixation in formalin.

Nigam et al, 2013, conducted a study on tumor and tumor like lesions in nasal and paranasal sinuses in 2013 in which thirty cases were included in this study. The sensitivity, specificity, and positive predictive value of imprint cytology, squash cytology, and frozen section were 100%, 100%, and 100%; 100%, 96.15%, and 80.0%; and 100%, 96.15%, and 80.0%, respectively. Overall diagnostic accuracy of imprint smears, squash smears, and frozen section was100%,

96.7%, and 96.7%, respectively. Imprint smears had better specificity as cell morphology could be more accurately appreciated.[18]

Mahadeva et al, in 2017 performed a descriptive cross-sectional study in the Department of Pathology, JSS Medical College, JSS university, Mysore over a period of two years. A total of 62 cases of surgically resected breast specimens were evaluated for features of imprint cytology, frozen section and correlation with histopathological diagnosis. Out of 62 cases, 33 (53.23%) were malignant and 29 (46.77%) were benign. Sensitivity, specificity and accuracy of imprint cytology were 100%, 43% and 98.36 % and for frozen sections were 100%, 96.55% and 98.39% respectively.[3]

Neduvanchery et al, in 2020, conducted a study on thirty-four patients with clinically node negative, in head and neck squamous cell carcinoma, and 85 slides were examined. The sensitivity, specificity, and accuracy of frozen section were 100%, 98.6%, and 98.9%, respectively, whereas for imprint cytology, it was 85.7%, 95.8%, and 94.1%, respectively. The mean time duration for reporting for frozen section and imprint cytology was 41.18 ± 3.62 and 18.12 ± 2.01 minutes, respectively.[19]

Tamhane AN et al, in 2020, conducted a prospective study on 103 patients for 1 year from July 2017 to July 2018. Of 103 patients, 51 (49.51%) were squamous cell carcinoma, 35 (33.98%) carcinoma breast, 9 (8.74)% carcinoma colon, 4 (3.88%) squamous cell carcinoma of skin, 3(2.91) basal cell carcinoma, and 1%(0.97%) malignant peripheral nerve sheath tumour. Frozen section diagnosis for margin clearance of the above organs showed the sensitivity , specificity, positive predictive value (PPV), negative predictive value(NPV), and accuracy to be 100%, 98.71%,100%,100% and 99.02%, respectively. The sensitivity, specificity, PPV, NPV and accuracy of imprint cytology for surgical margin clearance were 46.15%, 100%, 84.62% and 86.40%, respectively.[1]

Jain et al, in August 2021 conducted a study on 53 cases of CNS tumors, and all were subjected to imprint smear examination. Frozen examinations were conducted for 39 of these samples. The results of these two were compared and correlated with histopathological diagnosis. The observed results were analyzed. The most common primary CNS tumors were gliomas and meningiomas (28.3%) each. The sensitivity, specificity , positive predictive value and negative predictive value for imprint cytology were 86.67%,87.5%,81.25% and 91.3%, and for frozen section were 91.67%, 93.10%,91.67%,93.10%, respectively, with a corresponding comparative P-value of 0.56 (insignificant).[20]

Nomura et al ,in 2021 conducted a study in which about 78 cases of imprint cytology and frozen section based diagnoses against the final histopathologic diagnoses in terms of both histologic subtype (serous, mucinous, endometrioid, or clear cell tumor) and behavioral type (benign, borderline, or malignant) were compared. The cytomorphologic features of the tumor cells (nuclear atypia, papillary clusters, adenoma cells, and necrosis) in relation to behavioral types were also evaluated. While the diagnostic accuracy of imprint cytology and frozen section were similar with respect to behavioral type (87% and 88%, respectively), the diagnostic accuracy of imprint cytology was superior to that of frozen section with respect to histologic subtype (83% and 74%, respectively). Among histopathologically confirmed malignant tumors, the diagnostic accuracy of imprint cytology (62/64; 97%) was superior to that of frozen section. (58/64; 91%). The presence of necrosis and absence of adenoma cells were significantly more prevalent among malignant group than among borderline and benign groups ($P < .01$, for both).[21]

Kumarguru BN et al, in 2022, conducted a study in which histopathological diagnosis of 50 cases included neoplastic lesions (42 cases [84%]) and non-neoplastic lesions (8 cases [16%]). Correct

diagnosis was achieved by imprint cytology in 36 cases (72%) and radiological diagnosis in 25 cases (50%) by complete concordance. However, diagnostic accuracy of squash and radiology improved considerably by 90% and 76%, respectively, after applying partial concordance criteria. For the detection of neoplastic lesions, squash cytology had 98% and radiology had 80% diagnostic efficacy.[22]

Jain et al, in 2022. conducted a prospective study on 55 pediatric patients with clinicoradiologically diagnosed CNS lesions for a period of 2.5 years. Intra-operative imprint smears and frozen section were made and stained with hematoxylin and eosin stain. Diagnosis made subsequently on paraffin embedded sections was taken as the gold standard. Although the specificity (90%) and positive predictive value (96%) were comparable between the two procedures, sensitivity (91.4%) and negative predictive value (75%) of frozen section was more as compared to imprint cytology. Both the diagnostic modalities showed substantial agreement (k = 0.728).[23]

6.3 AIMS AND OBJECTIVES OF THE STUDY

To compare diagnostic accuracy of imprint cytology and frozen section with the gold standard histopathological evaluation on formalin fixed paraffin embedded tissue.

7. MATERIALS AND METHODS

7.1 Source of Data

All the tissues received in the Department of Pathology of Dayanand Medical College and Hospital for frozen section and imprint cytology over a period of 1 year from 15th September 2022 to 14th September 2023 and excised tissues received from the same organ and patient for histopathological evaluation for comparison.

7.2 METHOD OF COLLECTION OF DATA

INCLUSION CRITERIA

All specimen and tissues received for frozen sections and imprint cytology in the histopathology section of pathology department

EXCLUSION CRITERIA

All the histopathological specimens for which the frozen section was not sent.

PROCEDURE

The fresh tissues received for cytologic examination and frozen section intraoperatively will be examined grossly for the size of lesion, shape, circumscription, colour, consistency and presence of necrotic, haemorrhagic or cystic areas. Relevant clinical history along with reason for performing frozen section will be sought out.

The representative tissue will be taken from the lesion and three imprint smears will be made by gently rolling the tissue on two glass slides. Two wet fixed smear will be immediately fixed in 95% ethyl alcohol and stained with Haematoxylin and Eosin (H&E) stain and Toluidine blue stain. One air dried smear will be stained with Giemsa stain. The same tissue will be subjected to the frozen section in cryostat at -22 degree Celsius. The frozen sections will be cut at 4 micron thick and stained with routine H&E stain and Toluidine blue. Finally, the same tissue will be fixed with 10% formalin. Routine histopathological processing will be done and sections will be stained with H&E stain.

The slides prepared by imprint cytology, frozen section and histopathology will be interpreted and analysed.

DURATION OF STUDY

One year prospective study from 15th September 2022 to 14th September 2023 will be done.

OUTCOME

All the frozen section slides, imprint cytology slides and the corresponding histopathological specimen slides will be analysed in this study and correlated.

STATISTICAL ANALYSIS

Data will be described in terms of range; mean ±standard deviation (± SD), frequencies (number of cases) and relative frequencies (percentages) as appropriate. Sensitivity, specificity, accuracy, positive predictive value, and negative predictive value will be calculated. A probability value (p value) less than 0.05 will be considered statistically significant.

7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.

No.

7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION IN CASE OF 7.3?

Attached herewith.

8. LIST OF REFERENCES

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PROFORMA

Sr. No. _____

Prior Intimation:

Name : Age:

MRD No.: Sex:

Frozen section No(&Imprint Cytology No.):

Histopath No.: Address :

Time of Specimen Received for frozen section:

Clinical History:

Investigations(If any): ● Hemogram:

- Tumor Markers: CA-125/ CA 19-9 / CEA / AFP/ LDH/ Beta HCG / others

Radiological Investigation (USG/MRI/CT scan):

Size/ Location / Number of lesions / Mass / Calcification

Clinical Diagnosis:

Radiological Diagnosis:

Type of Specimen(Large Specimen/Small Specimen):

Site of Specimen:

Indications of doing Frozen section/Imprint cytology:

- Nature of lesion: Non neoplastic / Neoplastic (Benign /Malignant):
- Resected Margins
- Evidence of invasion
- Infection
- Others

Gross examination:

- Sutures

Signature of candidate **Signature of Supervisor**

- Size of the lesion:
- Location of the lesion:
- Consistency of the issue (Hard/Firm/Rubbery/Soft):
- Capsule:
- Specimen inked:
- On Cut Section:
  - Solid/Cystic Areas:
    - If cystic, color and consistency of the fluid:
  - Necrosis:
  - Hemorrhagic areas:
- Others (If Any):

Microscopic examination:

	Imprint Cytology	Frozen section	Histopathology
Normal Anatomical tissue:			
Borders of the lesion: (encapsulated/ well circumscribed/ poorly circumscribed/ infiltrating/ pushing)			
Epithelium (Intact/eroded)			

Signature of candidate **Signature of Supervisor**

• Necrosis • Hemorrhage • Inflammatory infiltrate ▪ Acute ▪ Chronic • Granulomas • Multinucleated giant cells • Organism (Bacteria/ fungus/any other) • Background • Architecture ▪ Gland formation ▪ Clusters ▪ Singly Dissociated ▪ Sheets ▪ Others • Cytological Features ▪ N/C ratio ▪ Nucleoli ▪ Chromatin ▪ Nuclear contours • Calcification • Stroma • Special features(mucin / keratin pearls/ granulomas/ etc)			

Signature of candidate **Signature of Supervisor**

Resected Margins (involved/not involved):			
Other features (if any):			
Final Diagnosis:			
Time of diagnosis:			

Deferred case (Yes/No):

Reasons for Deferred Diagnosis (frozen section / imprint cytology):

Freezing artifacts / Sample inadequate / Faulty technique / Fibrotic lesions / Collagenised tissue / Fatty tissue / Insufficient cellularity / others

Change in Surgical Management (Yes/No):

- If yes then what:

Concordant/Discordant:

Reason for discordant diagnosis:

- Sampling error
- Interpretation error
- Communication Problem
- Freezing artefacts
- Others

Signature of candidate **Signature of Supervisor**